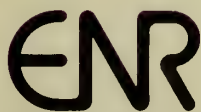


**Competition for Water:
Can Illinois Stay Afloat?**

**PROCEEDINGS OF THE
11TH ANNUAL
ENR CONFERENCE**

**Springfield, Illinois
September 20-21, 1982**


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**Illinois Department of
Energy and Natural Resources**

**James R. Thompson, Governor
Michael B. Witte, Director**

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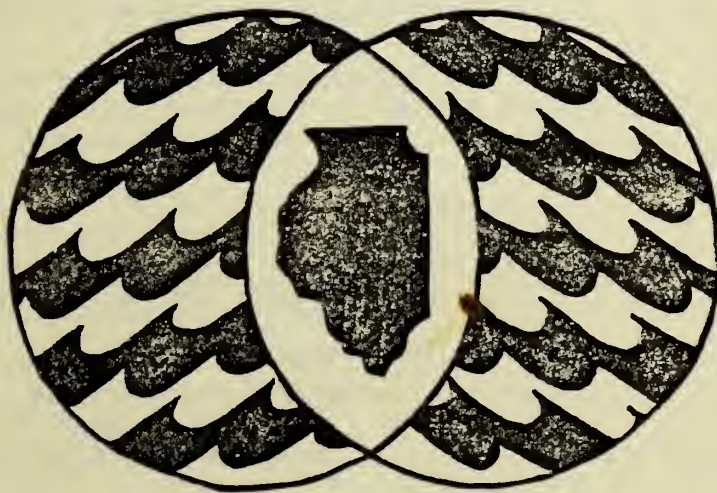
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FOREWORD

Water issues confronting us as individuals and as a nation were the focus of the 11th Annual Conference sponsored by the Illinois Department of Energy and Natural Resources, held September 20-21, 1982 in Springfield. Entitled "Competition for Water: Can Illinois Stay Afloat?," the conference highlighted existing and proposed state, regional and national approaches to the continuing competition for adequate high-quality water supplies at reasonable costs. The heads of Illinois' three environmental agencies addressed the manner in which state government should respond to these issues now and into the next century.

Contained herein are the speeches presented at the conference and the ensuing question-and-answer periods, based upon the actual transcripts of the sessions. As the oral presentations may differ somewhat from the prepared remarks of the speakers, their addresses as well as biographies have been included should clarification of a point or a copy of a formal paper be desired.

WELCOME ADDRESS

Michael B. Witte, Director
Illinois Department of Energy and Natural Resources

I'd like to welcome you to the 11th Annual Conference sponsored by the Illinois Department of Energy and Natural Resources. For those of you who have not attended our previous conferences, I'll point out that our agency is the state agency charged with data collection, basic and applied research, policy development, and public education concerning our state's natural resources.

And, as we are fond of pointing out, we are not the regulators or enforcers in Illinois. That's the Environmental Protection Agency. Nor do we adjudicate environmental matters; that's the Illinois Pollution Control Board.

But for those of you in the audience who have attended our previous conferences, I think even more explanation is in order. If you attended one of our conferences from 1971 to 1977, we were the Institute for Environmental Quality. If you attended one of our conferences between 1978 and 1980, we were the Institute of Natural Resources. If you attended our 1981 conference, we didn't know who we were! It was during our 1981 conference, I believe, that the Governor signed a bill changing our name to the Illinois Department of Energy and Natural Resources.

We therefore, I think, share with underworld figures and CIA agents a real appreciation for the cleansing, liberating effect that a name change can have sometimes.

For the truly curious among you, you probably received with your registration packets a copy of our 1981 Annual Report detailing the organization of our agency and the functions of its divisions, so I will not go into any additional explanation.

We view our annual conferences as one of our most important activities. We have, and will continue, to use these conferences as a means of exploring emerging natural resource issues in Illinois. It is our hope that these conferences provide an all-important opportunity for dialogue, for sharing of information and views, not only within Illinois, but between other states and Illinois.

This year's topic, of course, is "Competition for Water," the emerging competition for water resources, in Illinois.

My initial exposure to the issue of competition for water came not in government, but as a private citizen. In 1975 I became involved in a heated controversy surrounding the future of the Middle Fork of the Vermilion River in Illinois. Some of you may be aware of that controversy.

Plans were then underway to dam the Middle Fork River and to create a giant lake for recreation and water supply in the Danville area. It was clear then, at least to some, that the plan was proceeding without a clear consideration of alternatives and without adequate appreciation of the costs, the foremost of which was the possible destruction of one of Illinois' few remaining fine rivers.

In this skirmish I learned several lessons. First, that many of our natural resource problems are actually problems of governance, a result of political acrophobia.

Secondly, I learned that neither government nor private citizens can make wise resource utilization decisions without adequate reliable data and information concerning our resources.

Third, and most importantly, I learned that while politics may be at the heart of some of our natural resource problems, the solutions to many of our natural resource problems lay ultimately in the political process.

In 1976 we enticed a candidate for Governor to come down and canoe the Middle Fork River and to listen to arguments about why that river should be saved and why an alternative water supply for Danville should be found. To his great credit, he listened and he had the courage to take what could have been a politically devastating position on a very controversial issue. More importantly, as Governor he has followed through on his promises to preserve the Middle Fork and to help Danville find alternative water supplies.

That experience has had a lasting effect on my perspective of resource problems in general, and of water problems in particular. And so now here I am, part of the problem and, I hope ultimately, part of the solution.

We are fortunate here in Illinois that our water resources are abundant. We are not yet in the midst of a crisis as are other states around us.

But it is no secret in Illinois that we are mining our groundwater resources at an alarming rate, particularly in Northeastern Illinois. It is also no secret that Illinois, by virtue of its powerful industrial base, is among the leading hazardous waste generators in the country and that this, too, poses a very serious potential threat to the integrity of our water supplies.

It is also no secret that we are already facing serious water quality problems due to soil erosion and from the fertilizers, pesticides and herbicides that sustain our agricultural sector.

If current trends continue, the demand for water for agricultural irrigation in the future may challenge us with an unprecedented water quantity problem. In addition, our state aspires to participate in synthetic fuels development.

We are unlikely to see a radical reduction, but more likely constant increases, in industrial demand for water. For Illinois, a "postindustrial society" is not just around the corner. To the contrary, our vast energy,

water and soil resources are likely to assure Illinois' continued industrial ascendancy.

Thus, we really do have the makings of a water crisis in the future in Illinois.

But I think we have the opportunity now to take early action. Before we can begin to map ways to avoid future problems of water quality and water quantity in this state, we have to understand the factors that affect our water.

This conference has been designed to help us try to explore these factors together.

We will open our discussions with an overview by Mitch Beaver of water competition as it relates to Illinois. We will then turn to Illinois water law. This presentation will highlight the legal machinery by which we allocate, protect and adjudicate disputes over our water.

With this background laid, we will explore some of the possible institutional reforms and the private solutions to our coming water problems and move on to a broad outline of the larger water situation faced by our nation.

Other states, as I've said, are already experiencing serious water problems and some have taken remarkable strides towards solving them. The program today and tomorrow will feature presentations by representatives of some of these states. Their experiences ought to be invaluable to us in Illinois as we prepare for our future.

Tomorrow we will shift our focus to the ways in which competition for water resources manifests itself, as well as the ways in which resulting conflicts might be mediated.

Finally, tomorrow afternoon we will look ahead to the future and what it holds for Illinois in terms of water resources.

I believe we have the honor of offering you a strong program, interesting speakers. But most importantly to me, looking at our audience, not only from throughout Illinois but from states as far away as Minnesota and Mississippi, we have the opportunity to create a real dialogue during the coffee breaks through the day and at the reception this evening. I'd urge you to take advantage of these opportunities for dialogue because, after all, that's what makes a conference like this truly valuable.

INTRODUCTION TO THE COMPETITION

Frank M. Beaver, Director
Policy and Planning Division, ENR

Why in the world are we sponsoring a conference on competition for water in Illinois of all places? Everyone knows we have plenty. In fact, Illinois is considered a water-excess state, especially compared to the southwestern United States. We have the Mississippi, Ohio and Wabash rivers forming our borders to the west, south and east. And we have Lake Michigan, the fourth largest fresh water lake in the world. In addition we are blessed with abundant groundwater resources. How can we ever have serious water competition in Illinois?

Of course the water may not be in the right place at the right time or of sufficient quality to satisfy a particular demand, but can't we easily correct for that, given our abundance? Let's take a look at our demands.

Based upon our Illinois Water Inventory Program, a cooperative effort between ENR's Water Survey Division and the U.S. Geological Survey, along with other state and federal agencies, we can identify the demands being placed on our water system today. I'm quoting figures from the Program Brochure provided by the Water Survey for this conference.

The fact is that increasing demand in recent years by domestic, agricultural and industrial users, along with water pollution and the drought of 1980-1981, has heightened interest in the availability and uses of water in Illinois. The competition for Illinois' water resources is greater today than at any previous time in our history. The total withdrawals for 1980 were 42 billion gallons per day, one billion of groundwater and 41 billion from surface water.

But compared to our enormous supplies, why should this level of demand, even with projected increases, be of concern to us?

I alluded earlier to the fact that water competition has a spatial, temporal, quality and quantity character. Competition within a geographic area results when any one of these elements cannot match the need. Let me cite just one example.

In Northeastern Illinois, all of these elements come together to produce intense competition for water. Many suburban communities obtain their water supplies from the deep sandstone aquifer system. This withdrawal is about three times faster than natural recharge. Therefore new supplies of water to replace about two-thirds of this withdrawal are necessary.

But what about Lake Michigan? Lake Michigan diversion is held to 2,068 million gallons per day, or 3,200 cubic feet per second, by a federal court decision. This diversion formula is based partly on international politics, partly on water quality needs of the lake and partly on the amount of water we return to the lake. The available water for Illinois' use as public water supplies, industrial water supplies, for navigational purposes, and for maintenance of water quality in the Chicago River system is influenced by the amount of water we return to the lake. Theoretically we could use more if we

returned it, but here the conflicts between water quality and quantity become apparent.

In fact, we sowed the seeds for today's water competition in Northeastern Illinois back in 1900 when the Chicago River system was reversed - diverted from Lake Michigan into the Illinois River. That decision was made primarily for water quality - public health reasons - to protect the water quality of the lake. Today we are spending billions to operate, maintain and improve the locks and dams and transport systems to guard against overflows to the lake in the name of water quality. There is no shortage of water -- high quality water, maybe.

How about the temporal characteristic of competition in Northeastern Illinois? Lake Michigan acts as an enormous time buffer and, to the extent of its availability, helps to overcome the feast-and-famine nature of water supplies. The current allocation system takes this into account. The same is true for the deep aquifers. Beyond that, any new supplies from river systems are subject to the vagaries of climate, creating short-term variances in water availability.

Actually, we spend enormous amounts of money in Northeastern Illinois trying to control the short-term excess water we receive, through flood control projects, trying to keep from storing that excess water in basements and on otherwise productive lands.

Obviously, there are many other examples throughout the state of the quantity, quality, spatial and temporal relationships of water competition and of man's sometimes futile attempts to modify, control or enhance one characteristic or another in the name of water management. But a better understanding of these relationships will certainly help us to mitigate the conflicts.

The conference is intended to explore the competition in Illinois today and in the future, by understanding the current legal, institutional and political mechanisms in place which both create and resolve conflicts.

The second session, a panel discussion, will bring together speakers from Illinois, Florida and California to illustrate the characteristics of water conflicts in their respective states. The object, of course, especially in the case of Florida and California, is to learn from other places, both their successes and failures. Barry Commoner, director of the Center for the Biology of Natural Systems of Queens College, noted author and lecturer, will present the keynote address discussing water conflicts from a broader perspective: the nation and the world.

Tomorrow's sessions will be devoted to problem solving, both from a theoretical perspective and, again, through examples from other states and regions. Finally, the directors of Illinois' three environmental agencies - the Department of Energy and Natural Resources, the Pollution Control Board, and the Illinois Environmental Protection Agency - will provide their insights on solving the water issues into the 21st century.

I welcome you to our conference and hope that the next two days are both educational and thought-provoking for you.

ILLINOIS WATER LAW

Donald R. Vonnahme, Director
Division of Water Resources
Illinois Department of Transportation

Good morning everyone. I see a lot of faces that are friends of water resources.

What I'd like to do this morning is walk you through a general history of how we got to where we are regarding the development, enforcement and administration of water use law in Illinois and tell you about some problems that we think are arising, problems that we're trying to be prepared for, and methods of solution that we are currently considering.

In doing that, I'd like to talk a little bit about the development of private water rights in Illinois and how that development really was the basis for getting to where we are today in dealing with public water supplies, public waters of the state, a public trust doctrine, and how state agencies became responsible for the administration of state water use law.

I'd like to talk to you a little bit about two areas in which we're "going to school" on what we might call Western water law, appropriative water law, permit water law. We already have this type of water law in Illinois today, namely, the Levels of Lake Michigan Act and the authorities that we have in the Kaskaskia River watershed. I'd like to talk to you a little bit about something that we fear--general water shortages--and then talk a little bit about federal intervention, things that can happen if the states don't really have their act together. Then, I'd like to provide a little more detail on what my agency, as lead, is doing in the development of water law for the State Water Plan.

At this time, I would like to give you a quick rundown on the State Water Plan. Mitch advised you that my agency is lead on the State Water Plan. We're currently coming to the end of our second year in that planning effort. We have 11 agencies of state government that deal in water here in Illinois. We do not have a department of natural resources to unify these agencies' efforts. This particular administration has chosen what's called a Sub-cabinet to tie together agencies with overlapping missions and responsibilities, common responsibilities. Eleven of us sit on the Natural Resources Sub-cabinet. That group, as well as representatives of the Governor's Office, the Water Resources Center from the University of Illinois, and Chairman Betty Lou Reed of the Illinois Water Resources Commission are working together in the formulation of the Illinois State Water Supply Plan.

The state agencies that are working on the State Water Plan, just to let you know the resource base and the expertise that we have to choose from, consist of the Department of Agriculture; the Capital Development Board; the Department of Commerce and Community Affairs; the Department of Conservation; the Emergency Services and Disaster Agency; the Department of Energy and Natural Resources; the Environmental Protection Agency; the Department of

Mines and Minerals; Department of Public Health; and my own agency, the Division of Water Resources in Transportation. With that particular group, we have a wide range of backgrounds from which to formulate Illinois' future direction and produce a plan that will insist we're ready not only for regional water shortages, but also for any water-related problem in the future.

The Water Plan is looking at 10 issues that fall at the margin of current state agency programs. We're worried that there are some areas where maybe one, two, sometimes three agencies have responsibility, but maybe nobody's really addressing that problem and it might fall through the cracks.

Today three of those issues that were identified by a large number of public hearings around the state deal with the issue of water use law. Those issues are: competition for water, conflict resolution and modification of current Illinois water use law.

The representatives from the Natural Resources Sub-Cabinet agencies--I see many of them in the room--will be issuing a 1982 progress report in December of this year. This is the second progress report. We anticipate one more year for this water planning effort. At the close of calendar '83, we will issue our final report and the agencies will be in an implementation mode from that time on.

The theme of my presentation this morning will be that "as water issues arose in Illinois, law followed it." Law, for the most part, did not precede, did not see the problems that were going to arise, but as the problems arose, the state used its powers in the water resources area to solve the problem. Law was then on the books that could be used as a basis for further amendments. These existing laws also provide us the basis for determining whether we should scrap them and start all over again.

I would say that one of the first issues dealt with in our state was competing private rights for a water supply. Illinois, being an Eastern state, chose to use the riparian principle, namely that owners along a stream have a right to the reasonable use of the water in the stream.

The problem, to those of you who are experts in semantics, lies in the determination of what the reasonable use of the stream might be. What is the reasonable use of the waters in the stream? These are problems that generally occur when there's a shortage of water. So riparian law, since it says that owners of land along the stream have the right to reasonable use, is good for making sure everybody gets a share. However, the enforcement of this principle is slow and time consuming. It does not respond well in times of shortages.

In my tenure with the Division of Water Resources, there have been at least two occasions where there have been either industries or municipalities which, during time of shortage, have actually taken all the water out of a stream leaving nothing for downstream users to utilize. The only recourse, under riparian principles, that the downstream users have right now is the courts. And the courts, maybe six months later, might have a solution to the

problem. The courts themselves might choose to practice hydrologic and hydraulic engineering and specify what demands the various users might place on the stream, but this is usually done very much after the fact. This slow response doesn't help us in getting through drought crisis periods at all. This is a problem that we see in the strict use and adaptation of riparian principles only.

These early adjudications started in the mid-1800s, around the 1840s, at the time public water supplies were being developed. People saw a need for developing a water supply for an entire town or an entire community, not just an individual homestead.

Problems that naturally arose at this point in time were related to the strict application of the riparian principle. What happened if the town wasn't located on a stream? How did they get water for their community of 100 or 200 or 500 in these early days?

Nowadays, a population of 50,000 to 100,000 occurs typically in many areas of Illinois. Almost all counties have a town of this size. Past legislatures have seen fit to treat these landlocked municipalities as riparian users, even though they weren't. Statute was promulgated and passed which allowed municipalities to condemn for access in the interest of establishing a public water supply. This is probably one of the most unheralded statutes we have on the books. This simple provision has eliminated much of the controversy which could have existed in our state that still does exist in many other states.

However, these Illinois municipalities are still subject to the riparian doctrine, that is, reasonable use. If we were experiencing a period of low flow, low rainfall, low runoff or water shortage, these municipalities could still be the subject of litigation by downstream users as a result of using too much, of not being able to quantify exactly what the reasonable use of the water in the stream really is. Even though the statute, to date, has eliminated a lot of controversy, the possibility of controversy still exists on a true and narrow following of the riparian principle only.

The next major problem addressed by Illinois and by a number of Eastern states at this particular time, again the mid- to late-1800s, was the designation and realization of something called "Public Waters of the State." These were waters in which the public had some very strong and undeniable rights. The issues that initially led to this designation were navigation and the establishment of a fisheries industry in navigable waters.

The item of most importance to the states when the public waters questions arose was the underlying principle that title to the bed of public waters went to the states at the attainment of statehood. As the result of the states gaining title to the beds of the public waters, these streams and lake beds then became a property for the states to manage in the public interest.

The legislatures of the various states were quick to realize that in public waters navigation, commerce and fishing, the use of those waters for the

public should be unhampered by private interests. Great powers were established by the legislature in order to properly administer and protect the public waters of the state.

However, the problem that we're having right now is that we realize we have some very great powers in the public waters, but exactly what are the public waters of the state? I guess the most strict and pristine identification of public waters would be those waters that were meandered as a result of the federal land survey that was conducted when Illinois became a state. We do have a listing of those, Lake Michigan being one, as well as elements of the Mississippi, Ohio, Wabash and Fox rivers. Public waters also include those streams that are now commercially navigable in fact.

There seems to be no great controversy of what the minimum criteria are for the designation of the public waters in the state. But there are a few other qualifiers that make it a very gray situation in Illinois as to whether a particular body of water is a public water or not. That's also one of the missions assigned to our agency in the pursuit of the development and evaluation of current Illinois water use law. What are public waters of the state? Do we need to propose or initiate a formal process to designate same?

Having established the public waters concept, legislatures then dealt with the Public Trust Doctrine. The Public Trust Doctrine is one which allowed navigation, commerce and fishing in the public waters of the state without the interference of private parties. It also is very clear and specific in that the legislature here established that the state cannot abdicate, we cannot get rid of, we cannot give away, this public trust responsibility. We can delegate it to someone if we wish, a unit of lower government, maybe even a private interest. But the people to whom these responsibilities are delegated must realize that it can always be revoked for cause at any particular time if the administering state agency feels that it's in the best interests of the people to reassume the Public Trust Doctrine and the responsibilities that go with it.

The legislature began to realize--as far as items which were now becoming water issues in the states (getting to the late 1800s now, the early 1900s)--that they were resolving water problems, they were establishing legislation to handle private water disputes, public water disputes, and they established a public trust principle and a public trust doctrine. As a result they were getting quite pressed to handle the day-to-day problems that do arise from addressing all of these problems.

This was when state agencies started receiving the powers to administer the various acts of the legislature. One of the first that my agency received was back in 1917. The act was the 1911 Rivers, Lakes and Streams Act dealing with public trust and public trust doctrine. In the public trust, the challenge, the charge, was very specific. It stated that the public trust is a title, and I'm quoting from statute, "held in trust for the people of the State that they may enjoy the navigation of the waters, carry commerce over them and have the liberty of fishing therein, free from the obstruction or interference of properties."

Another portion of the Act states that the state "can no more abdicate its trust over property in which the whole people are interested, like navigable waters and the soils under them, so as to leave entirely under the use and control of private properties than it can abdicate its police powers and the administration of government and the preservation of peace."

So again, the legislature was very strict, very narrow, very specific in stating that the public doctrine is to be protected and that the natural resources of the state are to be jealously guarded, particularly in the public waters and public lands. This doesn't say that we can delegate some of these powers. We can, and have done so in certain instances. However, the state always reserves the right to revoke those delegated authorities and, in subsequently refining the statute, also provided that the state could issue 40-year permits for the use of public waters.

However, I would say to you that the establishment and enforcement of the Public Trust Doctrine here in Illinois was the forerunner of being able to utilize Western water law, allocative water law. Here for the first time water withdrawal wasn't based on riparian doctrine. We were able to give a permit to say, "You, Mr. Applicant, can use 4 million gallons a day, a million gallons a day, whatever." That was the opening of the door for water allocation law in Illinois.

In our Public Trust Doctrine we have the basis of what many of the Western states are using right now for their allocative water law, that when we were allocating water from a public water within the state, the public use had to be considered first. And the public use wasn't only municipal water supply, it wasn't only industrial water supply, it was also the instream need, the fish, aquatic life as well as navigation.

Those are some of the things that we're considering right now and as you'll hear me say later, the determination of instream flow needs is one of the real gray areas, or the holes, that we have in determining what a region's water supply needs are. We're working quite heavily with our Department of Conservation, EPA and the Surveys at the University to help quantify what these instream flow needs might be.

I guess the first big issue that we addressed that does embrace allocative water law is the Lake Michigan diversion case. As Mitch was referring to earlier, the Lake Michigan diversion started back in 1900 when the Metropolitan Sanitary District of Greater Chicago reversed the flow of the Chicago River. The City of Chicago water treatment plant intake facilities were and still are along the shoreline of Lake Michigan. Prior to the reversal of flow direction for the Chicago River, the Chicago River flowed into Lake Michigan. In those days, we didn't have the sanitary treatment plants that we have now. We didn't have any, in fact. In periods of high runoff, polluted discharges went into the lake and were consequently brought into the water distribution system through the water intakes leading to quite a few tetanus, typhus and other water-related diseases.

So the thrust, the thought, in those days was to reverse the flow of the water so that this didn't happen. And ever since 1900 our sister Great Lake

states and the two provinces of Ontario and Quebec in Canada have been pursuing litigation to force Illinois to terminate the diversion of water from Lake Michigan. We've been in court since 1936; there's been court action in the '30s and the '50s and the '60s and the '70s that has led to the current allocation of 3,200 cubic feet per second of Lake Michigan water for use by the State of Illinois.

A problem that we ran into, though, in the Chicago area is that Lake Michigan is a very, very good source of water. It's easy; it almost requires no treatment whatsoever. And as we were required to allocate and monitor the use of Lake Michigan waters, we found that as we started our formal series of hearings--which lasted about 25 months--there were more desirable users of Lake Michigan water than we had water to give. Again, the Lake Michigan water is used for several purposes: municipal and industrial water supply, water quality, navigation. Since it is a diverted watershed, we have to guess each year how much water would have fallen on the 550 square miles of diverted watershed. That counts against our diversion also; it all must come from the 3,200 cubic feet per second that Illinois is allotted.

It is a very multiply-used resource, if you will. At the same time we were confronted with another problem up in the Chicago area, and that's that many of the water users which did not utilize Lake Michigan water were using what we called the "deep sandstone aquifer." Many people were using it, and at such a rate, that they were mining the aquifer. They were taking more out (about three times as much) than the natural recharge capability of that aquifer.

As we made our Lake Michigan allocation, we had two things in mind. First, to make the precious Lake Michigan water go as far as it could. Secondly, to get as many users as possible off the deep sandstone aquifer. That was a problem to our Illinois residents and it was also a problem to the State of Wisconsin which also used the deep sandstone aquifer as a source of water supply for Wisconsin communities.

As I look at my statistics here I notice that the Lake Michigan water allocation primarily involves about three counties in northeastern Illinois: Cook, Lake and DuPage. A little bit of Will. Three out of 102 counties, not very much on percentage-of-land area, about 3 percent. However, over half of the state's population lives in those counties.

Here we're basically an Eastern riparian state having all the problems that states which strictly apply to riparian theory have. However, over half our population is under the purview of allocative (i.e., Western) water law.

As I said, just in plain and simple terms, we're using Lake Michigan allocation experience to "go to school on." We spent a lot of funds on studies in order to allow us to make the allocation in the most refined manner we could.

We took a lot of time to make sure that we didn't have procedural violations, but we are really going to school here because we do have over half the

people of the state under this particular form of what I like to call Western water law.

Another area where we have this particular authority, but where we currently don't have rules and regulations promulgated, is over in the Kaskaskia watershed. We're planning to "go to school" here also. With the contracts that the state signed with the Army Corps of Engineers back in the mid-1960s, the state purchased water supply storage in both Carlyle and Shelbyville reservoirs. We also purchased water storage in a federal reservoir on the Big Muddy Basin. With the Kaskaskia Reservoir and Rend Lake, we do have authorities to allocate and sell state storage in the reservoirs to water users in the area. We haven't promulgated our rules and regulations for these reservoirs yet. We attacked the Lake Michigan allocations first because of the tremendous population base that was up in the Chicago area. That was a problem of a higher priority, and that's why we addressed it first.

For those of you who do have an interest in the promulgation of water law and rules and regulations pertaining to such, we're going to attempt to move with them over the winter and spring. Rules and regulations for the use of stored waters in Carlyle and Shelbyville reservoirs will be the subject of many public meetings.

The Kaskaskia watershed is one, though, that we are concerned with for a very special reason. I think you heard Mitch say, and I would agree, that currently we don't have too many regional water shortages in the state. I wish to speak to you on that next.

Down on the Kaskaskia right now we have a river with a pretty large drainage area and two federal reservoirs with state storage in each. There isn't that much municipal development in the Kaskaskia Basin. However, it is an area where we have some of the best coal reserves in the entire state, a little bit of high sulfur right now. However, that coal is highly attractive to synthetic fuels entrepreneurs, and synthetic fuels plants are very high users of water, consumptive users of water, for the most part.

So if, in order to utilize the resource of the Kaskaskia Valley, the promotion of synfuels were to come about, there could very possibly be a high consumptive use of water that might develop in the Kaskaskia Basin. In addition, since the coal is there, if we can ever determine a way to use high-sulfur coal immediately, power production is another very high probability for the Kaskaskia River Basin. Again, most of the state-of-the-art power plants are high consumptive users of water. Thirdly, something that's becoming more and more attractive to our agricultural producers here in Illinois is the use of water for irrigation. Irrigation can also produce a very high demand on water supplies, whether they be surface water or groundwater. I think in 1980 we had about 140,000 acres under irrigation, not too much when you consider the entire land mass of the state. However, the state's acreage under irrigation has been increasing at about 15 percent per year.

The thing that I, as a water administrator or a practitioner, realize is that the demand for irrigation or the demand for peak power usually comes at a

time--if you're in a drought--when you have low water and you're having the most serious outside demands for the limited water resource. This is especially true when we are talking about irrigation and power production.

These are all things that we're trying to stay aware of in order that we don't have to be "knee-jerk" responsive to issues as they're happening. As I stated earlier, this was the basis of the formulation for the law that we've got now. We'd like to be looking out to the horizon, getting ahead of things. If we promulgate rules and see that the legislation is passed in anticipation of these water conflict issues, then at least we've got a plan in our hip pocket and we're ready. That's the real thrust of the State Water Plan as far as Illinois water use law is concerned.

You heard me mention the term "regional water shortage." Regional water shortage is a term that we use when a region, not a municipality but an entire region's, water demands--whether they be municipal, industrial, instream low-flow needs, fish needs, aquatic biologic needs--when all these needs exceed the region's supply. We don't consider an individual town which doesn't have an adequate source as being a regional water supply problem. That's something entirely different and we have processes set up to handle that.

These regional deficiencies are what we are concerned with. I would say that probably what appears to be a reasonable thing to do is to establish a procedure--if we do quantify a regional deficiency--similar to what we have operating in Chicago. The current thinking is a result of hearings (and I'm going to talk to you a little bit about those, too) that we had under the auspices of Representative Reed's Commission on the State Water Plan as we went statewide to see if the general public felt that we were addressing the right issues and proposing reasonable solutions. Sometimes we had a proposed solution, sometimes we didn't.

During the hearings, the thought came out that if we did have a regional water problem and we did want to have legislation and statutes to handle the problems, don't implement the statute statewide, implement it only where the problem exists. That's where the term "water management areas" came up. Maybe for parts of the state that are not having a problem, the general riparian principle, the reasonable use doctrine, is enough.

In areas where we are projecting into the far future, the near future or maybe we're on it right now, in areas where we are going to have a regional water supply problem or a regional shortage, then maybe we ought to go with allocative water law in that area only. I think one interest group which appeared at many of the hearings was the water well drillers, primarily those who were servicing agriculture irrigators. I asked them, "What are your thoughts on the designation of water management areas here in Illinois?" I asked this question because another very important part of the State Water Plan is to integrate water quantity and water quality planning for both surface and groundwaters.

We're trying to mesh water quality, water quantity, surface and groundwater because they all act together. Right now we've got about four or five

agencies whose various authorities overlap somewhat, but we're trying to work as a unit and a team to bring the administration of the total water resource together.

This is the context in which I was asking the questions. The ag irrigators, the well drillers were saying, "Well, you know, we're not so sure. How big is your region going to be?"

And I said, "Well, gee, who knows, what are you getting at?"

They said, "Let's take a 'for instance' that we're over here in the Illinois River Valley where we have good sand aquifers and we're groundwater irrigating in Havana. We'd hate to be lumped in with a region that went to Springfield or Champaign where, maybe, those folks are having a problem. You'd be putting the limit on us to satisfy those needs over there."

We didn't really know where the regions would be but the thought was, "Don't lump us into something so big that you're going to hurt us. Maybe you can help us if you're considering the things a little closer to home."

Again, this is the type of responses that we did expect. After a few more meetings, the question was being answered, "We don't think we like any groundwater regulations at all."

In response I posed to them the problem, "Suppose you are located over in the Havana lowlands and you are irrigating. Maybe you're depending on crop production solely supported by irrigation, who knows? But say a city the size of Springfield chose to develop out in the Havana lowlands--and that's a city with 100,000 people--and say they decided to satisfy the public water supply demand by groundwater. Let's assume that they construct their well fields and start pumping, and all of a sudden the cone of depression for their well-pumping system took the surface of the water table below your well points and took it down enough each year that you could never catch up with it." I said, "Would you like some protection there?"

The answer to the question was, "Well, then we think we would." I guess the underlying answer was, "Yeah, we'd like some protection but we still don't want that region to be too big."

This is the way we use public opinion to guide us, but the thought coming through is that we probably do need some protections--that was only one example--but maybe not allocative water laws statewide. Maybe just in readily identified regional water shortage areas. This is where we're working very, very hard to get enough data on supply and demand to tell whether we have a regional water shortage area in the state or not.

Those of you who've practiced the hydrology of surface waters deal routinely with the gauging stations of the State Water Survey and the United States Geological Survey. I think we know pretty much about the quantity and quality of surface water in our state. The big void in our data base is quality and quantity information for groundwater. We simply don't know as much about

groundwater quality or quantity or location as we do about the surface waters of the state.

Since we're treating this water resources system as surface water and groundwater, we have to know that. If an area doesn't have any surface streams or the location for surface water reservoirs, does it have a groundwater resource? We must develop the capability to determine this soon.

In some areas of the state we've got a fairly good idea, but in a lot of areas we don't. That's one big void that the agencies are putting time and money into to see if we can quantify the sustained yield, the quality, and accurately locate our state's groundwater resource.

Another big void regarding needs. We can usually get data on what the municipal demand is, what the industrial demand is, but what is the real instream flow need? What do Mother Nature's creatures need in the stream? If we're going to treat the demand system wholly and objectively, we have to know that.

The determination of instream flow needs is an area where we're also committing dollars and manpower. Once we fill these data voids, though, we'll be able to take a look at a region and say, "Here's what the regional demand is, here's what the regional supply is, and we've either got a shortage or an excess." If we have a shortage or projected shortage, that would be an area we'd concentrate on for possible allocative water law. Something to deal with those regional shortages.

I think you can see that, to the present, our water law is a result of responding to issues and to problems that have arisen. What we as planners think a more reasonable thing to do is to get out ahead, take a look at some of those problems that we think are going to be appearing on the horizon and be ready for them so that we're not caught with our pants down trying to do something in a flap, in a hurry and, as a result, maybe get some legislation on the books that constricts us in the future from really handling water management in the objective manner in which it ought to be done.

Of all the issues in the State Water Plan, water use law is the one that's really going to come at the end. We're spending a lot of time because the other 10 issues probably will identify items that are or are not addressed by current statute or by proposed statute. We are the lead agency and, in my own agency, Gary Clark is lead for the development of the water use law issue and the research that's being conducted. Two questions we're asking ourselves are: Do we need completely new comprehensive water management legislation here in Illinois? Or would the full implementation of our current statutes be sufficient to manage our resources?

Many times, as we perform the in-depth research for legislation that's on the books, we find that the needed authorities are there, we're just not using them. Those of you who do practice in administrative water law or just administrative law know that, basically, there are usually two ways to handle the drafting of statutes.

One way is to proceed with a very gray and loose statute but very formal, strict, long and lengthy rules and regulations to implement that statute. The opposite approach is to proceed with very specific and detailed legislation and almost negate the need for any rules and regulations.

This is one area where we think we may have been remiss in that we really want to investigate and search the existing statute to make sure that the authorities we feel we need aren't already there. We might find that we would only need refined rules and regulations to give us the authority that we think we need to avert regional shortages.

A third thing that he's doing is determining the adequacy of the current statute with certain proposed amendments, or maybe just clarified state emergency procedures. Is it the feeling that we are only having problems in a water shortage emergency, that we really don't need any legislation to deal with anything other than that?

Finally, he is working to see whether or not a legislatively mandated water use reporting and registration system is something that ought to be done in Illinois. Right now we are receiving data, usually voluntarily, by water users who report same to a number of agencies. Some of the Western states and some of the Eastern states do have this statute on the books.

The conflict categories that Gary's task force are looking at are those that feature a surface water use conflicting with another surface water use; a groundwater use conflicting with another groundwater use; groundwater-surface water interface; developed waters impacting natural waters; the construction of reservoirs; and finally, atmospherics--uses and impacts on our natural rivers, lakes and streams when we do practice cloud seeding. These areas are being investigated to see whether current Illinois statute is good enough to handle them or not. At the same time he's developing a matrix of the Eastern and Western states to see what statutes they have on the books to satisfy the problems that will arise from the conflicts that I've just overviewed for you.

Once we do get that, we'll be taking a look and seeing whether we need new law or whether we just need to beef up our existing law, whether some other state has a statute that we could implement verbatim, or whether we have to come up with something entirely new.

This is the current thrust of our efforts. We hope to be able to finally report our results in December of 1983.

One thing that's always on our minds is federal intervention. We think it's important to scrutinize our legislation to make sure that something doesn't happen to us in Illinois as happened as in the Sporhase versus Nebraska case where, as a result of a state having too many qualifiers in their water rights statute, it was not upheld by the United States Supreme Court. What they thought was a water issue turned out to be an interstate commerce issue.

That will be another thrust that Gary and his task force will pursue as we go through our water use law analysis and development to make sure, primarily, that we can deal with regional water shortages in the State of Illinois.

Thank you.

Questions Addressed to Mr. Vonnhame

AUDIENCE PARTICIPANT: Does the State of Illinois have a system of priorities for water use? In other words, does it put municipal uses before agricultural or--

MR. VONNHAME: There is a prioritization established for the Lake Michigan water allocation. Municipal and industrial demands are currently at the top of the list. A statewide priority listing, mandated by statute, does not exist to my knowledge. In the application of riparian doctrine, the courts in Illinois have generally held that uses of water that are necessary for life come ahead of uses that are conveniences to life.

AUDIENCE PARTICIPANT: In the urban-rural fringe we're finding that Chapter 42 drainage is completely ludicrous in the idea of comparison with contemporary storm water management. Is somebody looking at that?

MR. VONNHAME: I would say, quite frankly, probably no. My agency primarily deals with Chapter 19. We do have some authorities in Chapter 12; however, I'm not aware of any major research effort for Chapter 42.

AUDIENCE PARTICIPANT: We're finding a real problem.

AUDIENCE PARTICIPANT: You seem to convey all the way through your talk that the only allocational mechanism under consideration is authoritarian allocation, where the state sets priorities and gives the commodity away free to those who meet the priorities. Is anything else under consideration: selling it, taxing it?

MR. VONNHAME: Right now the sale of water is only being considered over in Carlyle and Shelbyville reservoirs where we actually did put money into the construction of the reservoirs. But I am aware of nothing that we're considering now that would propose to charge for use of storage from the public waters of the state where we didn't have a capital investment to recover.

AUDIENCE PARTICIPANT: Does the groundwater use law differ from riparian law for surface water allocated?

MR. VONNHAME: Groundwater law in Illinois is the most poorly defined of any of them. It essentially says that you can drill a well and use as much water as you wish as long as the well is located on your land. That's a real basic description of it.

AUDIENCE PARTICIPANT: The 3,200 cubic feet a second that Lake Michigan has allocated to the Illinois River, now the Corps of Engineers, we're talking about modeling a study for 10,000 cubic feet a second. Now I understand that they've given up on that but now they're talking about 6,600 cubic feet a second. I wonder if you could expand on that?

MR. VONNHAME: Okay, the new 6,600 stymies me a little bit. The court had a five-year authorization to actually do a demonstration of increasing the discharge all the way up to 10,000 CFS and the two hangers on this demonstration program were that the lower river could not be in flood nor could the lakes be below their 10-year, long-term average as far as water surface elevation was concerned. During that five-year period they ran into the situation that for four of those five years we either had the lakes below the 10-year long-term water surface elevation or the lower river was in flood. We had about one year where Mother Nature cooperated and they just couldn't do the study in that amount of time.

What they did do, realizing that about halfway through that five-year period that they might not get this actual pilot diverting done, was to do a workup on computer. That's where many of the people in this room were involved for about an 18-month period as they held hearings around the state and had everybody furnishing data. The only thing that was really done was the computer simulation and not a true pilot diversion.

The authority or whatever they're doing for the 6,600, the new one--I'm not up on that, but I'm aware of no authority from the Congress for an actual hands-on, actual diversion demonstration.

CAN WE REFORM OUR INSTITUTIONS?

The Honorable Betty Lou Reed
Chairman, Illinois Water Resources Commission

When we seek reform do we mean change? Change for good is always implied, but how do we know what change in the name of reform may produce? Isn't it easier for all of us to work with less than heroic known quantities or is it worth the gamble for changing's sake? Do we necessarily mean change within the system, or do we achieve reform and change within the institution by changing our collective approach to that institution?

Come to think of it, ladies and gentlemen, who is the institution? Is it you as a special interest group, is it the agencies of state government, is it the public and their pseudo-apathy or is it, in all reality, my colleagues and me in legislative bodies across the country?

One of the nice things about speaking very early on in a seminar is that you get to help set some ground rules and that's what I'm going to do right off the bat. The institution, for the sake of our discussion, is government. The branch of government is the legislature at any level, be it county, state or federal. And no, it's not going to change, it's not going to reform and it's not going to improve beyond a limited degree in my experienced opinion.

And why should any of you really care all that much about what your respective legislatures do or don't do beyond the appropriations that are passed that affect you personally or that were your special interest? The truth of the matter is you have very little alternative because the resolution of the emerging conflicts in water use, competition for water, the vital economic aspects of water, the have and have nots of water supply ultimately will be made by the legislative branch of government at one level or another. And you, as technicians, academicians, interested citizens, theoreticians, have a major stake in that institutional process.

I've been in the Illinois General Assembly for eight years and before that I served four at a county legislative level. In the course of those 12 years I specialized in water-related problems and legislation, originally because my district's eastern boundary is Lake Michigan and its western boundary is the massive Fox Chain of Lakes and it was politically expedient for me to be interested.

Now that interest is because of my concern for water and it is every bit as sincerely great as yours. Our roles, though significantly different, are equally important. Because one isn't going to succeed without the other.

A case in point is the subject addressed by my good friend Director Don Vonnahme, water use law. Don is a professional engineer of great ability and experience. He's absolutely hamstrung in his efforts to implement, enforce or interpret archaic Illinois water use law. Our academic colleagues at the University of Illinois have supporting data of every conceivable description to back any action that Don feels he may need to take in his

decision-making and implementing process. Yet Illinois is a state that says unless the state specifically permits an action to be taken in regard to water use, neither Don nor his eminently qualified support can move without legislative action at the state level.

The institution is critical to the changing required in water use law. As many of you know, Illinois was involved in a 10-year legal battle with the State of Wisconsin in regard to the additional diversion of Lake Michigan water. In the course of the 10 years, hundreds of thousands of dollars were spent and appropriated, I might add, on engineering studies and supporting data, ultimately conditionally approved by all of the affected Great Lakes states.

The final United States Supreme Court decision was made in favor of Illinois. After 10 years of concerted effort by every segment of Illinois government, the Division of Water Resources could not implement the United States Supreme Court decree without the constitutional passage of House Bill 2096 allowing the Division to do so.

Now, I've stated flatly and firmly that the institution won't change. Yes, it will in one respect. It will continue to increase its interest in your business. As the world has become smaller and smaller, so have the individual states in regard to the resources that know no boundaries. Water and air are literally ego systems unto themselves. But all of the bi-state compacts, basin commissions, international agreements don't mean a thing unless state-by-state legislative approval is given for implementation. Conflict resolution which is basic to the subject matter of this two-day seminar occurs only, ladies and gentlemen, with the unreformed and the unchanged institution.

A few years ago the Division of Water Resources asked me to sponsor a pretty controversial piece of legislation, the Coastal Zone Management Act. I accepted with alacrity and we went to work, they teaching me all of the technical and legal aspects of existing law at that time and what our bill was actually all about and I teaching them legislative politics based upon experience.

We ultimately lost the bill in final passage stage, but each of us had had one heck of a learning experience in the process. I learned that technical staff rarely consider the politics of passage of implementing legislation. If the tested program is sound in theory and practice, implementation and execution, why worry? How can you lose it? They learned that just because a piece of legislation is as pure in concept as the driven snow doesn't mean that it's going to pass. They learned that their three years of work on the management concept meant very little in our state capital because no one had ever heard of their research or their multiple hearings. They learned that Southern Illinois automatically hates Northern Illinois when it comes to the subject of water and there's little other than a personal appeal and a promise of a return vote that will turn an attitude around.

They learned, too, that two-thirds of the "yes" votes we received were because of personal friendships, favors owed, respect for the hard work we'd done, political party support, regional professional courtesy and the fact

that the technical staff expert who was assigned to me and to them was the most delightful young woman who could have sold ice to Eskimos and half of the House fell in love with her.

That's how we passed the House and darn near made it through the Senate. You have to admit the merit of the legislation had absolutely nothing to do with its outcome.

Surely there is a lesson to be learned there. Each view has a professional and personal dedication and experience in some aspects of the resource. That is order. You are a special interest group whose interest will manifest itself in change: changing conditions in supply and demand, use, conservation and protection of purification and processing, transportation, lending, borrowing and even a little theft from an aquifer if things get really bad; changes that will only be accomplished by that institution that doesn't even know there is a problem.

Obviously, changes have to be made and it's not going to happen unless it's you who does the changing. I urge you to start thinking politically about the water issue of greatest concern to you.

As you listen these next two days, turn your head around and think in terms of the real end product, the tools necessary to resolve the problem. Passage by the institution of the law is necessary to recognize, define and give you the authority to implement the solution.

I personally sit with two different groups whose greatest concern in this whole world is the incredible multifaceted damages inflicted by acid rain. I sit with these groups not as a scientific technician or expert of any kind. I sit with them as a politician. We don't always understand each other but I can assure you that they resolve the issues and do the research on the problem and I pass the enabling legislation.

We need each other. I will say that I do advise both groups immediately to take a beginner course in political science so that they know the institution that they must recognize holds the key to ultimate resolutions.

To develop rapport with your legislative bodies, the lengthy process needs to begin today. Today people are water conscious, if it's only to be sure that there's going to be enough to mix with their bourbon tonight and brush their teeth with. Now is the time to build on that interest. Now is the time to get yourself a sponsor for enabling legislation that you will need three to five years down the line. That sponsor I can assure you isn't responding to the conflict for water, he's responding to the public interests. It's his source of votes. He knows it and you will, too, if you will begin to think politically.

Put yourself in his shoes. Politicians are well-intentioned human beings with human frailties and subject to human nature. It's you collectively who have the responsibility to make him or them aware of what you think or know or have great concerns for the future of. He isn't going to sit down and read solutions for competing water demands just for the exercise. Human being that he is, he'd much rather take his free time to spend an hour

playing with his kids or taking his wife out for dinner. That's why the institution isn't going to reform. The institution doesn't know that you're out here trying to resolve the profound complexities of competition for a limited water supply.

The burden of changing the institution is not upon the institution, it's upon you as a special interest group if you intend to resolve these many conflicts. For our mutual success in the future, H₂O can no longer have only your interpretation of the two parts hydrogen, one part oxygen equals water. You must begin also to translate H₂O into how to operate politically. That is, only then can H₂O actually equal water in the most complete sense from your theory to resolution. That's the way to really reform our institution - from your point of view and that of all of us so vitally concerned with the future of our most valued natural resource.

Now, ladies and gentlemen, if there are questions, I promised Mitch that I would give honest answers, but as politicians and legislative bodies, we can do a course in political science right here if you are a bit interested. I simply am urging you to collectively put your heads together, get them out of the water and think in terms of that legislative body that holds the ultimate resolution in the palm of its hand if you but find yourself an interested sponsor, one who will stick with you, one who will be your spokesman, your advocate. It takes a long time to pass legislation and better you start right now while there is a public interest in water. Thank you very much.

Questions Addressed to Representative Reed

AUDIENCE PARTICIPANT: Why do you think the Senate voted it down?

MRS. REED: I know and I'll tell you later. Anything else?

AUDIENCE PARTICIPANT: As a Representative from Lake County, what do you see as a better version of local water law than what is presently in existence? There are about six different possible districts or special districts that are possible. How could that be improved upon?

MRS. REED: Well, again I've told you I'm not a technician, I'm a politician, but I can tell you immediately that with Lake County as impacted as we are by the allocation system and with the number of bodies of water that we have there, I was most interested in Don's allusion to the potential for management areas. You had a piece of legislation being researched, in fact, by the Department of Energy and Natural Resources that would have provided us with the background to pass legislation that would give us the option of going to a referendum and regionally or geographically setting up water districts that could deal with the pollution and recreation aspects. Any of the aspects of water as it impacts that population. I think that we need special districts because of the diversity of the State of Illinois. For that reason as well as the geographical mistrust between Northern and Southern Illinois.

AUDIENCE PARTICIPANT: I checked over the roster and I appear to be the only one from the State of Indiana. I happen to work for our Lieutenant Governor. By the way, our Lieutenant Governor does a lot in our state, but I might add as a representative of the State of Indiana, we presently have a commission that was recently formed by the Governor of our state. It's a water management act commission. We're working on a water management act at this time. It's presently in draft situation. But I was wondering if, collectively, the State of Illinois is looking at the water problem in regards to a comparison to the Sunbelt states or lack of water belt in the southwestern part of the United States?

MRS. REED: I think that's being done but it's being done at our executive level of government. I'm Chairman of a House standing commission called the Water Resources Commission and we legislatively deal with a variety of problems that are either brought to us by the Chief Executive or by the agencies in state government that we relate to. There is no thrust that I know legislatively to this effect other than the State Task Force which was appointed by the Governor to pursue all aspects of the use of our waters.

I think as a person from Indiana, I can tell you that our Governor doesn't want any diversion of Lake Michigan water to the Sunbelt states, has said so, as has your Governor and has Governor Dreyfus of Wisconsin.

AUDIENCE PARTICIPANT: Could you give us an elementary lesson in good politics? How do you overcome the parochial interest or the long-term interest of the overall state?

MRS. REED: You begin first of all in the legislative process. We have spokesmen for particular interests who emerge over a period of time and I would say that I emerged as a spokesman for water probably over a matter of 2-1/2 to 3 years. There's a new General Assembly, there are new legislators to be elected this year in the entire country. Find yourself a person who is vitally interested in water, maybe not because he's interested in water but because, like me, his district had a great deal of interest in its water so it was expedient for me to become interested. I truly did not know a thing about the Fox Chain of Lakes until I was elected from that district. I was a natural to be sought out as a potential spokesman, and in a legislative body all you do is speak a half a dozen times on a given issue and if that issue comes up, your colleagues all turn and look to you to see what you have to say on that issue.

So the development of a spokesman, and then his development of support, is critical. Each of you can go to every member of the Illinois General Assembly and stop by his office and chat with him for 20 minutes and that's fine. He's going to listen to you and he's going to be polite and he's going to enjoy your discussion. But as soon as he goes to the House floor, whatever he's interested in is going to take precedence.

Now, in Southern Illinois I've been told by good friends who normally would support practically anything I came up with, "Betty, I can't vote for a piece of legislation that may bring more water down the system. You know I won't be here next session if I do anything to that effect." And that same

colleague will come to me in the middle of the summer and say, "My God, the drought situation is so bad, can't you help us with some more water down the Illinois system?" So, you know, it's a complete conflict.

But I would suggest that first and basic is to find yourself someone in the newly elected legislature that's coming into your state, somebody who has no alternative except to be interested in water because of his legislative district and its geography, he's a natural for you, and then you begin to support him as he supports you. Director Vonnahme, Director Witte and I all started out in exactly the same way. I helped them, they helped me. It goes back and forth. I've become the spokesman for these two groups.

The same thing will happen with whomever you choose to be a spokesman for your interest, and only on the basis of personal friendships. From then on the need that Vonnahme talked about, when it happens in that particular region, is the only time we'll get it altogether.

AUDIENCE PARTICIPANT: Do you think the reduction in the size of the House will make our job easier or more difficult?

MRS. REED: I think it will make it more difficult because you have fewer people to deal with the problems. It would have been nice to have that additional 77 there and potentially spokesmen for water. They're going to be spread much more thinly.

Thank you very much, ladies and gentlemen.

ON PRIVATIZING WATER AND WASTEWATER SERVICES

Steve H. Hanke
Professor of Applied Economics
The Johns Hopkins University

The early speakers this morning set the stage for me. We had first the civil servant tell us that we were having a crisis in the water resources field. Then we had another civil servant telling about all the great things that his particular unit was doing to solve or attempt to solve these problems. Then we had a politician tell us why the water resources scientists should get together and learn how politicians operate so they could both collude and operate more effectively in the political process and that would help solve these problems.

As you might gather, I take a somewhat different view of the world, one that is perhaps a bit more close to the French author Balzac in 1833 when he wrote The Country Doctor. He said, "One does not enlighten a government, and of all governments, the least susceptible of being enlightened is one that believes it sheds all the light."

With that quote, I'll let Balzac set the stage for me now and begin my formal remarks before the questions. President Reagan has committed his Administration to the task of reestablishing a real federal system of government. In a letter to his Presidential Advisory Committee on Federalism in November of '81, which was chaired by the President's "good friend,"* Paul Laxalt, Senator from Nevada, the President stated that his "Administration is committed heart and soul to returning authority, responsibility and flexibility to state and local governments."

In addition to reestablishing federalism, the President has also committed his Administration to reducing the role of government in the U.S. economy. The President's economic policies are based on true liberal principles.

For example, in The Economic Report of the President, which was transmitted to the Congress of the United States in February of this year, the President's own words were: "My economic program is based on the fundamental precept that government must respect, protect, and enhance the freedom and integrity of the individual. Economic policy must seek to create a climate that encourages the development of private institutions conducive to individual responsibility and initiative. People should be encouraged to go about their daily activities with the right and the responsibility for determining their own activities, status and achievements."

Let us now examine the economic implications of the President's principles and policies for the provision of what have been referred to traditionally as "public services." To accomplish this, we must determine: first, which services should be financed by what level of government; secondly, which public or private organizations should supply public services.

*The words were used by the President in the same letter.

So we have a split here: one issue is who is going to finance, and the next issue is who's going to supply?

These questions can be answered, and the proper governmental role in financing and supplying public services can be determined, by applying the following principles:

First, public services should be financed by the users of services who reside in the governmental unit or combination of units that are geographically coincident with the spillover of direct benefits from the public service.

Second, public services should be supplied by the public or private organizations that can provide them at the lowest real cost.

The following advantages ensue from the application of these two principles:

First, the citizens' demands for public services will accurately reflect the undistorted preferences of users. The distortions that are created by grants and subsidies from the central government to state and local governments, which artificially reduce the direct cost of public services to users, will be eliminated.

Second, geographical expenditure discrimination will be avoided. For example, when a public service project generates localized direct benefits, tax finances will not be extracted from the entire nation to finance the benefits that are received in only one region.

Third, public services will be supplied by those public or private organizations that can provide them at the lowest real cost.

The application of these principles of federalism and free enterprise to water resource development and management provides us with a clear example. We have chosen water because it is a scarce commodity, particularly in the western states, and because the water supply sector of our economy is facing problems of crisis proportions.

For example, a Presidential task force has determined that most of the nation's large publicly owned urban water systems have badly deteriorated capital facilities and require rehabilitation. The investment required to accomplish a renewal from now until the year 2000 would run between \$75 and \$110 billion.

We first deal with the issue of financing. At present, the major source of financing for water and wastewater projects in the United States is the central government. For example, in the fiscal year 1983, the U.S. Environmental Protection Agency will allocate \$2.95 billion, or 67 percent of its total budget, for direct grants to state and local governments for the construction of sewage treatment plants.

The U.S. Corps of Army Engineers and the Bureau of Reclamation will spend \$2.1 billion in the same period for water projects. In addition, publicly owned water systems are eligible for federal subsidies through grants and loans under several programs, including those from the Farmer's Home

Administration, the Economic Development Administration and the Community Development Block Grants Program.

Due to the locational specific nature of water resources, however, the spillover of direct benefits from the management and development of most water resources projects is limited to localities or regions. Hence, the central government in Washington should not have a role in the financing of the planning, development and operation of these civil works. These activities should be financed by project beneficiaries through fees and/or benefit taxes, which are levied by local or regional governmental units or by private companies.

Next, we address the issue of supply. Urban water supply, for example, is a "public service," and it can either be supplied by public or private organizations. In the United States, private water companies serve about 31 million people and public organizations serve about 190 million.

As a result of their differing incentives and regulating mechanisms, private firms tend to perform better than public enterprises.

A large body of empirical evidence in the United States supports this conclusion.* By identifying the factors that determine costs, econometric studies allow us to identify the cost differentials that result exclusively from private versus public supply.

Whether the public services be water supply, wastewater services, fire service, police protection, refuse collection, ship repair, air transport, urban bus transport, electric supply or ambulance service, we obtain the same result: for the same quantity and quality of service, the public supply is approximately twice the cost of private supply.

This finding has resulted in a rule, the "bureaucratic rule of two." To determine the cost of switching from private to public supply, we must simply multiply the private cost by two.

Not surprisingly, the econometric studies of performance in the United States are verified, when we make international comparisons. We find, for example, the French experience with private water companies most instructive. Private French water companies dominate internationally in research and development, as well as manufacture of water and wastewater equipment.

For over 100 years, private water companies in that country have operated successfully under two basic types of private arrangements: one is the concession or franchise and two is affermage or "farming-out."

*This evidence is reviewed in three recent books: Cutting Back City Hall (1980) by Robert Poole, Jr.; Better Government at Half the Price (1981) by James T. Bennett and Manuel H. Johnson; and Privatizing the Public Sector (1982) by E.S. Savas.

Under the concession system, a public body contracts with a private firm to construct, operate and maintain capital facilities as well as handle customer relations and billing. Concessions are awarded to a firm on the basis of a low bid, that is, a water or wastewater price, for the right to supply a given quality of service over the length of the concession.

The private concessionaire finances all the capital works and operates at his own risk all of the facilities. At the end of the concession, which is usually 30 years, the concessionaire must return the system to the public authority in its original condition. This means that during the life of the concession, the concessionaire must replace all worn-out equipment and also recover its capital investment.

Affermage constitutes the second type of system used in France. This system operates in the same way as the concession, with one major difference: the system's capital works are financed and owned by the public body. To amortize these works, the public body simply adds a surcharge to the private tariff that is levied by the private firm. The length of the farming-out arrangement is shorter than concessions, running no longer than 12 years.

These two types of uniquely French arrangements have given private water companies in France the incentives to reach a superior level of performance relative to their public counterparts in other countries. If we are to improve the state of the supply of our "public services" in the United States, we must set in place policies that allow us to follow the French example.

We must, therefore, first eliminate statutes and regulations that limit the ability of private individuals and firms to freely compete in the provision of public services, and secondly, we must actively pursue policies of privatizing these activities by instituting concession and farming-out arrangements.

If we follow the French example and privatize the provision of water and wastewater services, we will expand the role of free enterprise. And this will lead to reduced costs, improved service and greater equity in the provision of these services.

In meeting our new challenges and opportunities, we could well remember the advice of the 19th-century economist Frederic Bastiat when he said, "The worst thing that can happen to a good cause is not to be skillfully attacked, but ineptly defended."

Thank you.

Questions Addressed to Mr. Hanke

AUDIENCE PARTICIPANT: Do you have any information on the cost of water to the recipients? You're assuming that the private sector, you said, is providing - anybody can provide - good quality of water. It's a question of cost.

MR. HANKE: That's right, and the cost will be about twice as high if you do it publicly as if you do it privately.

AUDIENCE PARTICIPANT: Do you have documented evidence of that in France?

MR. HANKE: Yes, I do, as a matter of fact, and I have a considerable amount of documentation here in the United States. There are three recent books that document a great deal of this evidence. One of them is titled Cutting Back City Hall. It was published in 1980 and the author is Robert Poole, Jr.

The second one was 1981, Better Government at Half the Price by James T. Bennett and Manuel H. Johnson.

And the last one is Privatizing the Public Sector, a 1982 book by E.S. Savas. Any of those three books, although they're not original studies, documents the original work that was done in water supply as well as many other sectors.

Now, one thing that is slightly confusing: you run into these apples and oranges problems when you start comparing data on prices and costs due to the fact that private corporations pay taxes, both property and income taxes. Sometimes people jump to the conclusion that maybe the per cubic meter price might be higher in a private organization than a public one. But even in that case you have to remember we're talking about cost, not final prices, and if you have low prices in a public organization that's exempt from taxes, the public treasury is going to have to pick up that revenue some way so they're going to just increase taxes on some other commodity. So water as a service might appear to have a relatively low final price to the user when it's supplied by a municipality. But this in many cases is largely simply due to the fact that they're exempt from paying income taxes and property taxes, but the municipality is going to have to turn right around and lay a tax on the citizens to pick up that revenue that they would get if the operation was private in the first place.

But anyway, these books go through the documentation and they're comparing apples with apples basically. It gets a little tricky. If you just look at the raw data, you can get yourself in a real problem with these comparisons. What we're looking at is the cost of delivering water per cubic meter.

AUDIENCE PARTICIPANT: Are you comparing in these statistics that you recite the municipality- versus the investor-owned that are regulated or unregulated?

MR. HANKE: Well, you do have some states where they're unregulated, but in the United States they all, on the private side, fall under the regulatory regimes of the particular states and those are included in the studies. You see, the French examples are a pure enterprise thing and about 80 percent of the water supplied in France is all by private companies. Very advanced, very sophisticated.

I know Americans are always stunned when they go and talk to these people and see what they're actually doing and the nature of the technology that they

use as well as the institutional arrangements. But it's totally deregulated. They don't have a public service commission that regulates their rates. They have no rate regulation whatsoever. They're given a franchise to serve a municipality and they enter into a contract with the mayor of that municipality and the contract includes an escalation formula for rates and all these things are right in the original contract that they have with the person who grants the franchise in the first place. And they work very smoothly.

Now, note that with the new Socialist government in France and the new nationalizations, one thing that is not being nationalized - which you would normally expect - would be something like a water supplier or wastewater supplier because we think of them traditionally as public services, after all, and no, they're not being nationalized, and nothing on the drawing board now. The reason is the local mayors who have a tremendous amount of political power in France have fought the central government like mad. They don't want the things nationalized because they know the cost will skyrocket if that happens.

AUDIENCE PARTICIPANT: You mentioned a rather large sum of money that the federal government is spending this year on water treatment. How does that compare, though, with the amount of money that's collected at the state and local regions plus user fees? What percentage of the total dollars being spent is that federal contribution?

MR. HANKE: I don't have those numbers right at my fingertips. Of new construction, it's fairly high on the wastewater end; water supply end is not nearly so significant. It's a minor portion on the water supply end. And the water supply money that I was talking about with the Bureau of Reclamation and the Corps of Army Engineers is primarily in large multipurpose projects that have other things besides just water supply involved. But the wastewater end: EPA is still a big ticket item for new construction.

AUDIENCE PARTICIPANT: What about areas in the West where, essentially, water projects have been subsidized by billions of dollars in federal money. Can that kind of a system work, a private system under those circumstances?

MR. HANKE: Well, a private system could work only if the people who wanted to buy the water found it valuable enough to pay the cost of providing it. One of the big problems we have in the West is that many of these projects were not built on solid financial ground. The prices are artificially low, which artificially creates terrific demands for the water and the projects and also demands that the rest of the taxpayers in the country finance them, and you're just developing irrigated acreage that should have never been irrigated in the first place.

Many of the problems that we have, many of the symptoms that we see in terms of Western water development, are due to the fact that these projects were public, they were subsidized. The prices were artificially kept low, and, of course, this crisis that we were introduced to this morning is simply another symptom of that. Once you have price controls on something and the price is held artificially low on a commodity like water, the demand starts outstripping the supply, and the only way you can solve the crisis is to get some

kind of public subsidy in there to augment the investment and capacity, if you want to retain the low prices to the users.

What's happened in the United States over the past few years is that the attitude towards water is starting to change so that the general subsidies aren't being injected into the system to continue to augment capacity and avoid this crisis, this gap between demands and supplies. That's why I think the only long-run solution, and the best one, would be to begin to think about private arrangements. To, in effect, privatize a lot of these activities so that ultimately users have to pay the real costs that they're imposing, and balance supplies and demands in that way, and of course you won't run into the problem.

I mean the market just takes care of -- the crisis is not there. You never have a crisis in a private market situation. You only have a crisis where you get the public involved, artificially keeping the price down and you can keep working your way out of that if somebody else is going to subsidize it all the time. But once the subsidies stop, then you've got a real problem.

AUDIENCE PARTICIPANT: In the United States, as well as Illinois, there are a great number of investor-owned water systems. Unfortunately, the bulk of them, probably 85 to 90 percent, are uneconomical. Have you addressed - and how can these companies ever obtain any sound financial feasibility?

MR. HANKE: Well, the problem here is the way we do things in the United States with this public utility or price controls we have. The problem is, as you point out, I think there's now one private water company in the United States, only one that has stock selling above book value. There's only one in the entire United States and I think that's down in Indianapolis, as I recall. And it's barely over book, it's not too much over book value.

The reason that this happens is that we have price controls, rate controls that have kept rates artificially low so they haven't been allowed to increase with cost increases. And what that does, it just shifts wealth from the owners of those firms to the users of the water service, and, of course, the owners have no incentive to invest more money in the utility, and the service starts going down. Then the public service commission starts complaining because the service is going to pot and the private entrepreneurs aren't responsible and they aren't doing things in the public interest, and on and on it goes.

Then pretty soon, ultimately, they say, "Well, we have to have the municipality buy the thing out and take it over so it can finally be run on a responsible basis."

What I'm suggesting is if we go to something like the French system, we would completely deregulate water utilities. We'd go back to either something that we had here in the United States, historically, for water and other services, - a franchising arrangement or some modified form of franchising - or we'd go to a system where the municipality actually owned the capital works and just farmed out the operation and maintenance to a private firm. One of these two combinations.

But we can't continue to think about these problems in the same way that we have because what was said earlier - that we do have a crisis - is, in fact, true. We do have a crisis, and the crisis is the result of the fact that the subsidies that keep flowing into the system and keep propping it up are, in fact, starting to dry up - and, I think, will probably continue to dry up.

AUDIENCE PARTICIPANT: Does your proposal to privatize include granting property rights in aquifers or does it require a state agency to put a price on water being pulled out of aquifers?

MR. HANKE: This is a question you raised earlier which I think is very important in the context of this group. There are various ways to allocate resources and organize things, and what I'm suggesting is we should try to think about doing more things privately and fewer things publicly. Therefore, in the context of your last question, I would not want the appropriate state agency to, in effect, own groundwater publicly and charge some kind of a pumping tax or user fee for those resources. What I'd like to see them do is define property rights in those aquifers and transfer the title, either by selling them at an open auction or there are other arrangements you could get: give part of them away to existing users and then sell the other part or some combination. But, at any rate, really get it out of the public sector; have private properties in those resources just like we do for surface rights, for land rights. Let the market process determine the highest and most valued use for those ground water resources.

What the conversation was about this morning, and the question you raised this morning, was that all the emphasis so far was on "we're going to use the political process and bureaucratic supply of these resources" and what I'm suggesting is that I don't want to use the political process for these things that can be done, and can be done more effectively, by using private property rights and the market process.

AUDIENCE PARTICIPANT: How would you protect, though, a pulling down of underground aquifer in five years? Eliminate the long-term program of protecting that community if you just transferred the property rights? They could go for five years and pull out.

MR. HANKE: Okay, you can transfer. You've heard of easements on surface rights? Well, you can have restrictions and covenants written into the titles that are transferred originally on these groundwater resources. You see most people think, unfortunately, that you can just do things publicly, you know, "there's no other solution."

But let me give you an example of something that most people think is "public": it can only be done by the public service situation. That's something like building code inspection. Now let me give you another French example with building codes. How do they handle that?

The contractor is strictly liable to meet the standards but they don't have any public building inspectors in France. They use just a statute law of strict liability and the contractor insures himself. Who is the policeman in the system? The policeman is the insurance company because it wants to make

certain the guy's doing the right thing so that it's not going to have to pay out on the insurance policy.

And you can do the same kind. There are all kinds of private arrangements that can solve problems that we have that even involve the public interest like safety in this building code example. I'm suggesting that it's a wise thing to do it for two reasons.

One is it costs a lot less, which frees up resources to be used in more productive activity. And the next thing is that it gives us a lot more freedom and flexibility as individuals.

AUDIENCE PARTICIPANT: I wanted to know, and it would be related to what he asked, how they set national standards, or do they in France? And do they do any kind of long-range planning and international planning?

MR. HANKE: Absolutely. We have kind of what I call phantom river basins because they don't have any budgets or any money and they don't really do anything. There they have river basins, but the river basins are, in effect, like banks, because they have standards and they use the model that you suggested where the public body, the river basin, sets the water quality standards and they change effluencies if you want to dump nasty stuff in there. Okay, so they set the overall ambience standards in the basin and to achieve their objective, they use effluent charges on the outfalls.

What happens to that money that comes in from those effluent charges? It comes in and forms the basis for capital loans made to either municipalities or private companies who want to build wastewater treatment plants. So, again, it's getting the price mechanism and the market working in there. In other words, they don't come in and say you can't dump such and such out here. They say you can dump it in here if you want, but you're going to have to pay such and such to do it.

Thank you.

WATER: THE CRISIS WE CAN NO LONGER IGNORE

Fred Powledge, Journalist and
Author of Water: The Nature Uses, and
Future of Our Most Precious and Abused Resource

The name that's been given to this conference is a particularly apt one, and I can only assume that it means that people who think about water issues in Illinois are ahead of most of the rest of the nation.

I know after hearing the other speakers today that that is certainly true. It's pretty well established now, or at least I think it is, that we are either in a crisis on water or we are very much on the leading edge of one. There is a surprising amount of agreement, I think, on the nature of the crisis or on the combination of water quality and quantity issues that seem to have jumped unexpectedly into our consciousness.

But few people understand yet that one of the major components of this crisis is competition. Competition for water is, in large part, responsible for the mess that we're in and competition is going to have a lot to do with the way we deal with the water crisis from now on.

So I congratulate the organizers of this conference for their foresight. And I commiserate with them in their anguish and frustrations that they're going to be going through as they, and the rest of us, follow this crisis to whatever its logical conclusion is going to be.

I suppose I'm here, a common reporter in the midst of a lot of people who really know what they're talking about, because I wrote a book about water. Writing the book itself was a long, involved process because I only use two fingers when I type. It was an educating one, as writing ought to be, but I've received another education in the past few weeks since the book came out.

My publisher thoughtfully arranged a small tour of what seemed like eight dozen radio talk shows in five days, and after four years of brooding about this book in silence, and hiding behind a typewriter, I got a chance to hear what other people thought about water.

I was surprised to find, although I really shouldn't be, that a lot of folks are prepared to be told that there is a water crisis. A lot of people already know that. After all, isn't there a crisis in everything else? It's how we communicate with each other these days.

But they are prepared then to be told, I think, that the water is running out and that X millions of Americans are going to perish on the streets tomorrow unless something is done about it by the 15th of the month, or something like that.

And as those of you who are familiar with the situation know very well, that isn't the way it works at all. Our water isn't really "running out." There's enough on the planet to go around and to keep going around for a very long time, even when we consider the wasteful ways in which we use it. The toxic chemicals that are heading down towards, and in some cases through, the aquifers and down the rivers to the intake pipes are not going to wipe out the population, or even a significant part of it, at any time soon. The water crisis is not the nuclear war crisis.

I do believe, however, that unless we change our attitudes and our practices very quickly, people in sizable numbers will be killed by what we're doing to our water. But the plague in this case will not be a swift and dramatic one and, as you know, it may never be attributed directly to water. Like a drought, we will hardly be able to determine its starting point. One day we'll wake up and we'll realize that it is here.

I do believe that water is "running out," in one sense. The enormous quantities of clean and usable water that we have at our disposal--and in too many cases, literally "at our disposal"--are being effectively reduced by, on the one hand, our poisoning part of it and, on the other hand, our wasting part of it.

The inevitable result--the result that is difficult to explain in 30 seconds on the evening news and so, therefore, never really gets explained--is that the water that remains will assume great value. There will be intense competition for it. That can be very good and that can be very bad, and chances are it will be both.

Your list of the competitors for the water that we have is probably a lot more complete than mine, because many of you are in much more intimate, daily contact with the issues of keeping Illinois afloat, as the rest of the conference title puts it. But let me spend a minute, please, telling you how I arrived at my list:

I started off to write a book about the wonders of water. I was, and I still am, a journalist with a somewhat childish interest in finding out how things work and then trying to put down on paper what I found out.

For some reason I got fascinated with water. I think it happened when I was on a trip to the Southwest and I realized, with that sudden shock that a lot of Easterners have when they go to the Southwest, that everybody doesn't automatically have as much clean, pure water as they might like. Some people don't even have water faucets.

I checked around and found that not too much had been written for the lay reader about water, so I set about finding out what I could: how much there was, where it was found, how we used it and what water's future seemed to be.

It was those last two items that changed the course of my research. At about that time the toxic chemicals were coming to the surface at Love Canal and at

a dozen other Love Canals around the nation. Some of the wasteful water projects that we had always dismissed, or some of us had always dismissed, as "more of that awful pork barrel legislation" were becoming so rancid that they were outrageous. Tellico and Columbia dams in Tennessee come immediately to mind, but as you know, there were many, many others.

I looked around and found that water--clean, unfettered water, water that wasn't stolen from one place in order to be used in another, or water that wasn't appreciated strictly for its ability to carry off chemical wastes--this water had very few defenders. And it had many enemies. Many exploiters.

Many were and are involved in the competition to use water and to use it in the cheapest possible way, no matter what condition the water may be left in when they're through with it. Water was decidedly the underdog and the victim.

All of a sudden, for me, writing a book about "all you ever wanted to know about water" seemed like a very irresponsible act. Instead of cataloging all the ways water was helping us, I found myself compiling a pretty gruesome list of all the ways we were maiming water and I found myself almost involuntarily becoming an advocate for the stuff--which is only fair considering that it keeps me alive.

You may see, then, why my own list of competitors for water is also a list of those I consider to be exploiters of water, those who have hurt water in the past and who by their treatment of water have contributed to this man-made, home-made drought that we're building for ourselves.

I don't apologize for this characterization, although a couple of critics who have read my book have suggested that maybe I should. But I do think it is only fair to point out that all of us are exploiters of water. All of us have been guilty of taking water for granted, of treating it as if it were a free good. All of us have gone through most of our lives paying very little attention and hardly any respect to this subject, to the substance that keeps us alive.

Agriculture must be on any list of water's exploiters. Of course, growing food and fiber is an indispensable pursuit, it's a perfectly worthy way to use part of the water that falls from the sky and runs down the rivers and seeps through the aquifers.

But the intensity with which farming is practiced now has had profound effects on the water supply. This is an intensity that some people sum up in the phrase "corporate agriculture" and one that recognizes more than anything else the all-important bottom line.

Pesticides and herbicides have leached down through the soil and into the aquifers that other people drink from. Attempts to grow the most possible soybeans, no matter the eventual cost in soil erosion, are threatening to

turn parts of the nation into dust bowls. Irrigation systems that look like something out of space exploration movies are depleting aquifers that we once thought of as the next best thing to forever.

It used to be said, most proudly by those who practiced it, that a good farmer always was careful to put more back into the land than was taken out of it. And now that saying seems almost as hollow as the ideal of a post office that delivers the mail or a grammar school that teaches grammar.

Industry is a major exploiter of, and competitor for, water. The water problems in industry used to be pretty simple: You worried about the amount of turbulence the factory created in the nearest river and you worried a little bit about the degree to which it depleted the dissolved oxygen, and you worried about whether it raised the stream's temperature enough to kill the fish. Or at least to kill the fish where they could be traced to your factory.

Now, of course, we know a lot more. Thanks to thousands of synthetic organic chemicals that have been developed since the end of World War II and that we have happily incorporated into what we call our "lifestyle," industry has now given us a catalog of horror stories from one end of the country to another, and we know that there's more yet to come.

The toxic waste dump that once was symbolized by Love Canal is now represented everywhere--in the woods of Maine, throughout the coves and hills of Kentucky and Tennessee, in the high-tech emplacements and suburban valleys of California, and even on the site of a former world's fair inside the boundaries of New York City.

The lesson that industry has taught us, I think, is that industry is at best amoral on the subject of water. I am aware that I am speaking in very general terms. I'm not talking about the one or two stereotypical rotten apples that spoil the barrel, although I know that there are some exceptions.

But I believe that, if allowed to, industry in general will gradually pour poisons into the nearest creek or aquifer. It will poison people's wells. Some elements of industry will do this even when they are not allowed to.

A third major category of competition for the usable water that we have left is what I would call development and growth. Our cities and suburbs have expanded in ways that squander a lot of water, a lot of good water. Speculation in real estate for second homes and condos has resulted in water's being transported to places that are environmentally fragile, and that has had a doubly bad effect.

Many of our cities, which otherwise represent an efficient system for transporting and dispensing water, have allowed their pipes to collapse to the point where billions of gallons a day of water that's certified pure for drinking are being wasted.

The people who run the cities do little or nothing about the collapsing infrastructure because cracked pipes that are beneath the streets are a lot less visible than crime on the streets or other issues that are perceived by the public and by the politicians as being crises. It takes courage for a politician to deal with a problem, even if it's a life-threatening problem when he or she knows that that problem can't possibly be solved in two years or four years or six years, and when it is solved, will provide the voters with really just more of something that they thought they had all along. That kind of courage is not widely visible at the moment.

Development, agriculture and industry are great exploiters of water. But I think the most careless and thoughtless competitor is government itself. Here I'm primarily thinking about the federal government.

The chemical companies and corporate farmers are pikers compared to the Department of the Interior which, along with a few other federal agencies, administers public lands in numerous ways that damage water. I believe the Environmental Protection Agency has gotten so bad that it should have its name changed.

I notice, by the way, that there is more interest in this meeting, at least according to the list of persons attending it, from the governments of Quebec and France than there is from the federal government.

We have several really fine environmental laws on the books--the national strip mining law is one example, the Clean Water Act is another. But government is woefully unwilling to enforce them. The excesses of the Corps of Engineers, Tennessee Valley Authority, Bureau of Reclamation and other building agencies in promoting extensive water projects, no matter what the cost in dollars or in environment, no matter what their very own cost-benefit analyses and Environmental Impact Statements show--these excesses are among the most grievous assaults that we've got going right now against our water supply.

Of course the members of my list have been operating for a long time to obtain and use and cast aside water, whatever the long-term results. And America has managed to trundle along from one crisis to another without ever before realizing if there was a water crisis on the horizon as well.

So why all the fuss, why are we here? I think the difference now is that all these wasteful uses and abuses of water have accumulated and multiplied to the point where we no longer have a comfortable margin for error, if we ever really did. We seem to be at what the people at the United Nations and the other think-tanks refer to as our "carrying capacity" for good, clean water.

What happens when we exceed that capacity is truly scary to contemplate when you consider that absolutely none of us could live longer than a few days without the stuff.

Against this backdrop of carrying capacity and competition stands the public, the people who need, use and drink the water. Us. These are the people who always before have depended on government to get them clean water in abundant quantity and to get it to them with a minimum of bother and expense. These are the people who will most directly be affected by the crisis and by the competition for water, and they are the people who are only now awakening to the nature and the magnitude of the problem.

They are not stupid about water, but they are ignorant about water. And for good reason. Until now there has been absolutely no need, very little incentive, for ordinary people to bother themselves with thoughts of water. Except in some parts of the country, it was always there whenever we needed it, whenever we turned on the faucet. I would bet that residents of most of our nation's urban centers, even now, do not really have clear ideas of where their water comes from. I live in New York City; we have probably the best water in the nation. A lot of people in New York City think it comes from the Hudson River. I don't quite understand that, but they do.

Now that people are learning about the problem, they want to know more; they want to know what they can do to help. I got some of the sense of this not long ago from that little extra education I got from those radio shows. A lot of the people who called in seemed to be not too surprised at the fact that there was a water crisis. What they wanted to know was what they could do about it. The normal agencies of information, they seemed to be saying, had failed them.

They were right. The people in my own field, journalism, haven't done a very spectacular job of explaining our problems with water, and so the crisis seems to be one of a series of unrelated incidents, when we all know it isn't. And government has done an even more inferior job of education.

One example of that could be found in a General Accounting Office report that was published last spring which found that 43 percent of the nation's community water systems that were checked in 1980 had violations of federal health standards, and that the public had been informed of only 11 percent of the violations.

So the people who call into the radio shows are confused. They want to do something about making sure that the water that their children drink is pure, but they don't know where to start. They want to do something about a scandalous waste of water resources but they don't know where to start there either, beyond a few basic home conservation techniques everybody knows about.

More than a few times I was asked if I thought store-bought water was safe. This referred to the water that some people, I guess a lot of people, buy in plastic jugs in grocery stores and spend a buck a gallon for, and that a lot of other people buy in little glass bottles with funny names on them and spend 6 or 8 bucks a gallon for. No offense to the representative from France.

One man said, "Is that gonna kill me, too?" He was speaking of the grocery store water and he was obviously a citizen who had lost faith in his society's willingness or competence to inform him about the safety of one of the most basic substances on earth and one that he had been taught by that society to always take for granted. And he was not an isolated example. One of government's first and biggest jobs as we undertake to tackle the issue of competition for water is going to be educating and then re-educating the public about water.

An equally big job lies in dealing with the public's relatively recent, and I think certainly well-founded, discovery that science and technology are not fountains of objective truth, that they do not possess some magical powers to solve our problems. We certainly can put a man on the moon, and maybe some day we will figure out a way to put a woman there, too. But that doesn't necessarily mean that our technocrats and our bureaucrats really know or care how many toxic waste dumps there are in the United States or whether the neighborhood around the Love Canal really is fit for human habitation.

These are only a couple of the problems that are going to be faced by those who hope to solve the water crisis. But they alone are enormous ones.

Add to this the fact that the federal government is in wholesale retreat on water and other environmental issues. And add the fact that the government is the single logical body that we have for coping with the problems of a substance that knows no political boundaries and obeys no laws except those of nature. Add all this together and you've got a crisis indeed. It is almost enough to make you want to give up.

But we all know that we can't give up. We could maybe give up on the crisis in the economy, and we could go massively, nationally broke, and a lot of us would go on living.

And we could give up on the energy crisis, and we could leave the cars in the driveways and walk to work.

But if we give up on the water crisis, we will perish. We have no alternative but to solve this one.

There is, of course, hope. All is not despair. And while I have seen a lot of reasons for pessimism, I've seen a lot that makes me optimistic.

Some "for instances": individual Americans, people who before might have classified themselves as apolitical or non-activist or housewives or factory workers, have gathered around local water crises and have caused some change for the better. Often it was the discovery of a toxic waste dump next door that got them started.

But others have organized around water supply issues, as I'm sure people in this state who are familiar with the works of John Marlin know. These grass-roots groups learn how to goad and embarrass government, learn how to do it

by scratch. How to manipulate the press and insure a spot on the evening news. They learn how to get something done about the poisons they were drinking. Sometimes it has taken a lot to get their voices heard.

Last week in eastern North Carolina, my home state, a group of demonstrators, mostly black and hardly well-to-do and therefore reminders of some other demonstrators I have seen there in other years, got themselves arrested to show that they did not like the idea of the state's burying soil contaminated with PCBs in their county because they feared it would ruin their water supply. Their leader was quoted as saying, "This is a life-and-death issue."

Another hopeful sign might be the result of a sort of blessing-in-disguise. The current economic mess we're in has made people more aware than ever of the true cost of the water-project boondoggles, and the costs of energy have made them aware of the expense of moving water around deserts and over and under mountains.

An example of the effects of economics and energy might also be seen in the relatively recent actions of an agency that I give a very hard time to in my book, the Tennessee Valley Authority.

For years TVA dammed every possible river in its territory, and when it discovered that it was running out of rivers for hydropower, it started burning enough high-sulfur coal to make it the nation's leading sulfur-dioxide polluter. Then it moved into atomic energy.

More recently, however, TVA has undergone what really looks like a change of heart, partly because the economics of this situation make growth-at-any-cost so clearly unfeasible, and also partly because TVA's leadership, I believe, really has accepted the notion that the environment has great value. It may be too much to hope for a similar change of heart from the Corps of Engineers or BuRec, but I guess I still believe in miracles.

The best source for optimism, I think, lies in the public in general. Even those citizens who have not yet seen a toxic waste site, who have not yet been advised to boil their water before drinking it for the next few days, or who have not yet had to carry Clorox jugs down to the National Guard tank truck while the city struggles to not only patch the 100-year-old water main but to find the plans for the 100-year-old water main--even these people want to do the right thing by water.

They're a bit selfish and a bit lazy, like the rest of us, but they want to be good environmentalists; they want to be good stewards of the planet where they live.

Every opinion poll on this subject that I know of shows conclusively that the vast majority of Americans of every stripe believe in protecting the environment--and they believe in protecting it even if it costs them a little money and costs them a little comfort. All they need is the proper leadership.

They, and we, need leadership to pull together what we know about the water crisis and to put it in terms that the lay public, and not just the technocrat, can understand and debate. I say debate, and I underline it, for water is very much a public issue. It is more basic to us than education or religion or civil liberties or even democracy.

We need leadership to coordinate and guide the processes we should have started so long ago: the processes of education and planning and open discussion and technical analysis and allocation, and--it may come some day--rationing.

Again, the only logical agency to do this job is the federal government. And again, we find the federal government unwilling to do it. We don't have much time to sit around arguing, so a lot of the responsibility is going to fall to the states.

It will be an enormous task: regulating what we do to and with water, overseeing its purification, assuming responsibility for what gets done once the aquifers are found to be contaminated or depleted or both, calculating the costs and risks and benefits and then explaining them to the public. And most importantly, gathering and publishing the simple basic data on water that we have never really bothered to assemble before, then taking the heat that all this competitive friction is going to generate.

The states will have many obstacles to overcome. One big one is their own reputations for being something less than protective of the environment in the past.

As I said before, I'm from the South, and I used to be scandalized by the way the governors and legislatures of my region were willing and eager to overlook and repeal if necessary even the simplest rules of environmental wisdom in order to "lure industry," as they always put it, as the newspaper headlines always put it.

Now I have lived a little longer and in some other places, and I know that it's not just the Southern states that have been doing this. Most states are guilty.

Some in the enlightened Midwest have even spoken of going into the water delivery-and-selling business. This is a problem, and a reputation, that most states are now going to have to overcome. Meetings such as this will be great ways to take steps in that direction.

Another reason for optimism grows directly out of the coming competition and that is the fact that as more and more people and institutions recognize the true value of water, fewer and fewer of them will be able to continue taking water for granted. We will have to stop treating water like a free good and more like the precious substance that it is. We will have to start paying a price for our water that is more in line with what it's really worth.

While I am an advocate of this sort of what folks used to call "consciousness-raising," I also realize that some pretty big problems could grow out of it. These problems are associated directly with competition for water. They have to do with who controls water, who sets the prices and who sets the priorities.

I've been a newspaper reporter and book-writer long enough to know that we do a lot of talking in this country about equity and equality and that we hardly ever achieve it. In fact, the only thing that is certain here is that a lot of the competition for water will be to see who can make a buck at the expense of those who are least able to defend themselves.

We have seen this many times before, of course. We've seen it in fuel shortages, in industrial relations, in agriculture, in slum clearance and urban renewal, in public works projects in general, and in the economics of race. A lot of very good people have given up parts of their lives and some people have given up all of their lives trying to undo these social wrongs.

But here we are not talking about social wrongs; we're talking about who controls a substance that is necessary to life on this planet. If control of water gets into the wrong hands--whatever the "wrong hands" are, because we haven't even defined that yet--we will be allowing a crime against life that is unprecedented in our history.

Again I must say that I do not envy you--or, as it must correctly be stated, I do not envy us--in the job that is going to occupy so much of our time and energy during the coming years. But the job must be done, because with every aquifer that we find to be contaminated, every free-flowing river that we hobble with dams and diversions and channels that don't work right, we effectively reduce our supply of good, clean water. And the competition for the water that remains grows more and more intense, and more and more uncontrollable.

Thank you very much.

WATER-RELATED PROBLEMS IN FLORIDA

Dottie Kirkwood-Hamilton
Florida Wildlife Federation

It's an honor to be here this afternoon, to have this opportunity to address you and I hope that you will find the occasion enlightening. I don't know if I can live up to the expectations set up by Mitch Beaver this morning.

Those of us from various states, he said, were invited so that you might learn from our successes and our failures. Well, I will pose many more questions than I will supply answers this afternoon.

Water is the most important and critical resource affecting the future quality of life and the economy in Florida. Florida has an abundance of water with 10,000 miles of rivers and streams and over 7,000 lakes.

Florida has more than 1,000 miles of coastline. That makes it the greatest of any contiguous state in the nation. Florida is also known as the world's most productive underground water supply. Eight hundred cubic miles of water means the Florida aquifer contains 100 times more water than that in Lake Mead.

How did a state so richly endowed with water find itself on the brink of disaster? In 1981 Florida suffered from the worst drought in its history. The lowered water table in north-central Florida caused land to drop creating 200 new sinkholes this year alone. Saltwater has intruded from the ocean into many of our freshwater wells.

Previously free-flowing springs in Central Florida have now gone dry. The effect on wildlife is dramatic. The interruption of water flowing into the Everglades National Park has resulted in the loss of 90 percent of that area's wading birds. The economic impact is frightening.

Residents in Monroe County, Florida pay as much as \$500 a month for their water. How could we have been so short-sighted, so negligent, so wasteful to pollute and piddle away such an invaluable resource?

Some of the problem no doubt has been greed. Until recently the objective of water management in Florida was to get rid of water. For many, cheap swampland drained was a quick profit.

Part of the problem has been ignorance. For years we paved the landscape with roads and parking lots unaware of the consequences. There is a controversy brewing in Florida over one of man's advances into development. The original network of water resources in Florida was rich with marshes, swamps and flood plains. They provided man with quite a lot. During floods they contained and absorbed water. During droughts they conserved it.

Daily wetlands filtered nutrients from the water providing a rich haven for fish and wildlife. These wetlands even influenced our weather. A

controversy over the relationship between wetlands and the weather has received a great deal of attention in our state recently. The national press has seized upon the theory that wetlands affect local rainfall patterns and they have named it the "rain machine."

Simply stated, the rain machine theory wonders whether man's drainage of wetlands is responsible for the documented decrease in South Florida's rainfall over the last 10 years. The evidence is mounting that, indeed, wetlands play an important role in generating rainfall by the process of evapotranspiration in which moisture rising and vapor rising off of vast flood plains into the atmosphere returns to the land along with vaporization from the ocean waters surrounding the peninsula. Has man's drainage of the wetlands disrupted this rain machine? Some water managers suggest that that is a far-fetched notion.

But, in fact, many changes in climate resulting from man's interaction have been well documented. Historically, South Florida was 90 percent water and wetlands. Ninety percent. Today 40 percent of those areas are gone.

One study in Florida found a permanent reduction of evapotranspiration as a result of this urbanization. I do not find it amazing to theorize that the destruction of nearly one-half of a natural system would interfere with the normal working of that system. I would be amazed if it didn't.

What does boggle my mind is that there are those in Florida who continue to regard swamps and flood plains as enemies, something to be drained, divided and conquered. Some of you may be wondering when I talk about a reduction in rainfall, lowered water table and historic drought when all you've seen on television lately is the flooded Everglades and drowned deer.

As I stated before, Florida is historically wet with 56 inches of annual rainfall and more thunderstorms than any other state in the nation. A reduction in rainfall does not mean that we don't have water.

But if you build on flood plains, drain swamps and pave wetlands, then the problem arises of what do you do with the water when it comes? It isn't politically popular or feasible to flood homes, even ones built in a flood plain.

The modern system that permits this alarming situation to exist was begun in 1947 when the control of floods in the Everglades was turned over to the U.S. Army Corps of Engineers and the politically appointed Central and South Florida Flood Control districts. The emphasis of both these organizations was on draining, ditching and diking in the name of flood control.

Little consideration was given to the conservation of fresh water. The result was that the water table was kept low by draining billions of gallons of water - fresh water - into the Gulf of Mexico and the Atlantic Ocean. In 1950, with a population of 2.7 million people, that kept the land dry while still providing drinking water. But in 1980 Florida had a population of 10 million and attracts 7,000 new residents a week.

In 1981 Florida was hit with a drought. With a water supply that was now insufficient for a thickly populated coast, agricultural water was rationed

for the first time in Florida history. Today draining water to tide is no longer popular.

So the Flood Control District, renamed the South Florida Water Management District, not only held fresh water in conservation areas but pumped water off agricultural lands into those areas. The result, as many of you saw on Nightline or World News Tonight: high water diked in these conservation areas drowned wildlife in massive numbers.

Ironically, all this went on while the Everglades National Park was starving for a drink. In its natural state the system allowed this excess water to flow southward through the park. Now the water has been dammed up by artificial dikes. The result is sort of like a large bathtub, as it were, which floods the wildlife inside while those to its southern boundaries thirst. No doubt one reason for the inadequacy of this system was sheer ignorance when it was built. The slow flow of water from Central to South Florida into Biscayne Bay was little understood at the time.

Ignorance is an essential concept to the people in this room today. It's important to me. I get paid to enlighten people about Florida's water problems, and I believe that those of us concerned about water-related issues must communicate more effectively to the public. Not to each other, not to conservation and environmental groups who are already aware. They're already interested.

Public opinion is powerful. I want to reiterate a point that Representative Reed was candid enough to make this morning. The political process responds to what is expedient and that's usually public pressure.

I'd like to give you a recent example. Environmental groups in Florida have tried for the past two years to call attention to even the possibility that inadvertent weather modification was caused by draining all their wetlands. But when Sports Illustrated wrote an article about the rain machine, the Governor of Florida called a symposium of respected scientists from around the nation to discuss the issue. Now, Sports Illustrated is hardly a technical journal read by experts in the field. But with a weekly readership of 16 million, it can and did grab public attention. Unfortunately, the majority of the public may not seek out information on even so vital and basic a resource as water.

And I'd like to leave you with that thought as Representative Reed urged you to get involved with the political process. The involvement of people of your caliber in communicating issues to a broader audience is badly needed. I have brought with me today a videotape that I would like to present to you. I wrote and produced this program during 1981 but it still gives an overview of some basic water quality and quantity problems in Florida.

I wanted you to get a chance to look at our state rather than just hear about it. (Whereupon a videotape film was shown.)

CALIFORNIA PERIPHERAL CANAL

Thomas L. Kimball
Honorary President
National Wildlife Federation

Let me tell you a little bit about myself. I was raised in the Southwest where water is liquid gold. I spent 22 years in Washington at the funny farm where they say most of our national policies are made, but it gives you - that 22 years in Washington - a little different perspective of what the parochial interests usually are among all of our states and territories.

Just a couple of observations before I tell you about a case history in California that I'd like to make. One is concerning the quality of water.

I was in Washington when the water quality programs were located in the Department of Health, Education and Welfare and administered by the Public Health Service. We laughingly said that it was in the seventh sub-basement of the Department of Health, Education and Welfare because that was about the priority that it had at that time and the doctors who administered that program felt that if you could filter water, chlorinate it and it didn't give you diarrhea, it was clean enough.

A number of us said that we were particularly interested in the aesthetic values of water as one of its myriad uses, at least felt that it deserved something better than that. So we encouraged Congress to enact, with our insistence, the Clean Water Act and the subsequent amendments. As a consequence, the programs were moved from the Department of Health, Education and Welfare to the Interior Department who said they would give water quality improvement the kind of priority that it deserved.

Well, that lasted through one Secretary and the next Secretary wasn't that much interested and so Congress created a new agency (they create them by the dozens there about every six months). The Environmental Protection Agency then became the recipient of the water quality programs of our country.

If you follow the problems of water quality closely nationally, you'll recognize the fact that not only the rules and regulations but the enforcement of those rules and regulations are usually dependent upon the dedication and capability and of the administrator of that agency. Some of them want to do it properly, some of them would just as soon not - or are maybe even opposed to the actual mission of the agency they head.

Well, if you think you've got problems in Illinois between the north and the south and the people in it, you should live in California. We've had legislation introduced in the state legislature to petition Congress to make two states out of California, to divide the northern people from the southern people. That's how well we get along.

California is the nation's richest and most populous state. In fact, you can take where I live now, down around San Diego, and combine that with the metropolitan areas of Los Angeles, about 15 million people. Then you add San Francisco on to that and that pretty well makes up the 22 million people in California, mainly living in urban areas and along the state's coast.

Its moderate temperatures, in fact, is the reason I live there; the mean temperature in Valley Center, California, is 72 degrees and it never frosts. It usually doesn't get colder than 50 degrees nor hotter than 90. But that combination has brought people and problems to the Sunbelt.

Combine that with the fertile soils and that has made agriculture California's number one business. Water is the lifeblood, or that liquid gold, nourishing the economic advances of the state. The principal problem is that most of the water is located in the northern part of California while most of the people, the best growing temperatures and the best class-one farmland are located in the central and southern valleys.

In the north, the San Joaquin and Sacramento rivers drain almost 40 percent of the entire state and consequently flow the greatest amounts of surplus fresh water. These two rivers join to form the San Joaquin-Sacramento Estuary comprising the Delta, the Suisun, the San Pablo and San Francisco Bay area.

The Delta is fresh water and the Bay is brackish, and together they form, at least biologically, the most valuable and productive areas in the state.

The Estuary sustains very significant and important fish and wildlife resources. The most important are the anadromous fishes: salmon, steelhead, striped bass, sturgeon and American shad. All spend most of their lives in the Estuary or ocean but they all spawn in the fresh water upstream. Many resident fishes are present, the white catfish being the most important species.

Waterfowl are the major wildlife group within the Estuary wetlands and those wetlands form the vital habitat essential for their continued well-being.

The Suisun Marsh covers 90 square miles and constitutes 10 percent of the remaining wetland in California which has already lost over 80 percent of its coastal marshes. Salt water intrusion is the most significant factor controlling the marsh's suitability as waterfowl habitat.

The fresh water Delta encompasses 1,100 square miles, has 700 miles of intertwining waterways and 50 islands devoted almost exclusively to farming.

These two important rivers have 90 public agencies that have long-term contracts for water delivery to the San Francisco Bay area, the San Joaquin Valley and to Southern California.

Collectively, they supply water to more than one-quarter of the state and to two-thirds of the entire population. Thus, the Delta is California's most important resource, it is the center of the state's water industry and has

and will continue to be subject to enormous environmental and political pressures.

Currently there are two major water suppliers and contractors: the Federal Central Valley Project administered by the U.S. Bureau of Reclamation and the State Water Project administered by the State Water Resources Control Board of the State of California. Both groups store water in reservoirs north of the Delta and release it when needed by the myriad water users.

Reservoir releases also generate electric power and then ever-increasing amounts are diverted from the natural river channel for consumptive users, mainly domestic and agriculture and some industrial.

Both water-contracting agencies have been increasing their diversion since 1952. The state has contractual commitments to deliver approximately 2 million acre feet more per year than present deliveries and the Central Valley Project has a somewhat lesser commitment under existing Congressional authorizations. But that could change at the whim of Congress.

Suffice it to say that the substantial diversions of water at critical periods from both projects seriously degraded the Delta and Estuary ecosystems and consequently resulted in an extremely deleterious effect on fish and wildlife.

Ever-increasing diversions will be catastrophic to those values. Attempts have been made by the water authorities to minimize adverse impacts by developing minimum flow standards during critical periods. But according to the California Department of Fish and Game, it does not appear, at least in their minds and in mine, to be very realistic for water to be released for environmental and wildlife needs while the state's number one business and the attendant great economic values go without their needed water.

The most serious deficiencies identified by the Department of Fish and Game include the present locations of the diversion sites. This causes sporadic reverse flows in the Delta that confuse migratory fish, sweep young fish and their food supply from the major nursery areas and create a dead end at the diversion sites that require all fish salvaged at the screens to be handled and to be transported if they're to be saved.

After 30 years of research and study, and of government agency bickering and political infighting, it was finally concluded that the best solution had to include development that would minimize adverse environmental impact and still meet a substantial share of the water demands of a rapidly developing Southern California. That's the political reality. Yet the environmental groups in California succeeded in blocking many of the diversions for that same 25-year period.

That solution was the authorization, financing and construction of the Peripheral Canal. This canal, with the attendant new diversion sites, could divert larger amounts of surplus water across the Delta, better screen the canals from fish loss, prevent salt water intrusion, better protect the Delta from all of these adverse impacts, and in essence do a much better job of

protecting the integrity of the Delta and Estuary ecosystem while meeting increased demands for water.

You'd think after all the years of study by the experts and all the infighting and the final conclusion that they came up with, that the thing would be resolved, right? Wrong. The only problem was the cost and the public attitudes towards the project. It had been estimated the Peripheral Canal would cost somewhere between \$4 and \$5 billion. That amount of capital outlay ran the price of future deliveries of water much higher than the cost currently being paid by the water contractors, most of the current low cost of water subsidized by the government.

Consequently, most of those water users opposed the canal. The major agricultural interests reasoned that the present water delivery systems provide cheaper water and they were not convinced that they should have to pay for minimizing or mitigating the disastrous environmental damage that inevitably occurs with ever-increasing diversions of water.

Also they had a division of public attitudes, the same problem you have here in Illinois. The people of Northern California are opposed to having "their" water diverted to Southern California. Southern California has a sizable population of elderly retired persons like me and the water users skillfully exploited every citizen's concern about the tremendous cost of the project. They took out ads in the paper and had some very cute television spots that asked the Southern Californians why they should have to pay for this canal and the water to come south when the primary beneficiaries would be the large landowners of agricultural land and the new immigrants who are coming almost daily to an already overcrowded Southern California.

So where you'd expect most Southern Californians to say "Yes, we want that additional water," most of them voted against it because of the cost.

The state legislature was caught up in this very vocal and controversial problem and, as so often happens with legislators, if they can pass the buck they will - with all due apologies to Representative Reed. So they passed the buck to the people by a referendum that was on last November's ballot known as Proposition Number 8.

And, of course, because of the reasons mentioned, the people of California voted the construction of the Peripheral Canal down. Now we in California are back to square one in our long-standing efforts to resolve the ever-continuing battle between resource development and environmental protection.

The question comes up: Can the controversy ever be resolved in a manner that protects the overall public interest rather than in favor of a limited special interest that has the greatest political clout? I tend to think so, provided certain things happen, and I'd like to present those to you now.

First, I think the state legislature should consider and authorize the construction of the Peripheral Canal and the bonds to finance the construction. Our legislative system, if it works properly, is really great. Legislatures have committees, they have hearings, they have money, they listen to the

experts and to the public, they represent all of the people. They usually can come up with a conclusion that is in the overall public interest. And if they can overcome the political power of the special interest lobbying groups, I think collectively they could do the job. That's my recommendation for the solution of California's water problem.

I'm frank in admitting that that's not likely to happen in California. So the legislators, if they continue to be intimidated by the controversy, will probably refer the proposition back to the people. Only this time they should appropriate sufficient funds for television and other mass media use to assure that the public fully understands the issues involved.

The second is that the people of Northern California must be assured that only surplus water will be diverted south. And that was something that was absent the first time around. This means that enough water must be reserved for projected growth in the northern part of the state that is served by the Sacramento and San Joaquin rivers, and the integrity of the Delta and Estuary must be preserved with the authority both to manage the water and enforce the protection inherent within the authorizing legislation.

It doesn't do any good to authorize something and then not provide any means to enforce it.

Three, the public must be convinced, and the legislation provide, that those who benefit and use the water from the canal pay for it. This concept is the greatest problem in our country. On the federal level, during my 22 years in Washington, the greatest waste of the taxpayers' money involved water projects. The Corps of Army Engineers presents to the Congress what they call the Omnibus Rivers and Harbors Bill and within it a water development project of some kind for almost every congressional district in the United States. And no congressman challenges another congressman's project no matter how bad the project is, because the arguments always come back as "If you don't vote for my project, I won't vote for yours." As a consequence, those authorizations sail through the Congress with very few - if any - public hearings and no one really knows what public values are there and why the public taxpayer should pay for it.

Let me give you an example. In one of those authorizations, there was a cost of several million dollars to build a reservoir where the primary beneficiary of the stored water was a catfish farmer. That's the type of boondoggle that has helped create our great budget deficit. Very large and very expensive water programs like the Central Utah Project, the Central Arizona Project and the Central California Project are built by the government and subsidized by the taxpayer. The users are supposed to pay the money back. But do you know what rate of interest they pay? Three-and-a-half percent on most of the projects. Wouldn't you like to be able to get money at 3 1/2 percent today?

If you own a treasury bond you know you get 10 or 11 percent on that, and that's what the government has to pay you for it. So the difference between 3 1/2 percent and the current prime lending rate on a capital outlay of billions of dollars is subsidized by the American taxpayer. If we are to ever balance the national budget, our national leaders must say "No!" not

only to water project subsidies but all subsidies for every segment of our society.

Subsidies are the reason we have a trillion-dollar debt and most of our current taxes now go to pay that interest. We couldn't operate our own personal finances that way and the government can't either. They're finding out now that they must stop spending more than they take in soon with no better place to begin than with the water programs.

This means that contracting government agencies, the U.S. Bureau of Reclamation and the California Water Resources Control Board must not be subsidized to any great extent by the taxpayer. Project costs must be borne by those who use the water.

If the average Californian not vitally interested in an added water use can be convinced that he will not have to subsidize the project and pay for it because he doesn't use the water, then he'll vote for it. As a consequence, projects like California's Peripheral Canal can obtain the voters' approval.

Four, finally, the entire public must be convinced that there is some benefit in a project for the individual voter because there's significant built-in costs to maintaining the so-called aesthetic values and even some of the economic values of fish and wildlife. That was the principle reason California had such a long controversy over the Peripheral Canal. Paying for a project is the most difficult to sell so the public must be convinced. Most voters will cast their ballot against any referendum they do not understand or have little or no interest in if there is no readily apparent benefit to them as an individual. And you can count on it when you're dealing with the public.

But everyone has an interest in the natural environment. Public opinion surveys, both current and dating back to the 1960s, show the average citizen concerned, interested and desirous of having government at all levels actively engage in minimizing adverse environmental impacts on these projects where possible and enhancing the renewable natural resources where practical.

Minimizing those adverse impacts and enhancement of the environment must be an integral part of the legislation, and it is in the Peripheral Canal. The public must be made aware that the protection and enhancement of those natural values such as variety and numbers of fish, wildlife, native vegetation and natural beauty is what is in the project for each individual citizen.

Five, the economics of the project must be fully explained to the voters. None of this was done in the past referendum and that's why it failed.

Four to five billion dollars is a lot of money, even in these times, and the political climate currently is to reduce government expenditures. I think that's again a public mandate to our legislators. And so in that kind of a climate it's going to be difficult to get voter approval for that kind of an expenditure.

A sizable share, too, of that cost is for environmental protection. So the public is entitled to know what they'll be getting for their money.

Professional economists must be enlisted to shed more light and knowledge on the subject. The problem here is that most economists do not understand nor, I think, do they appreciate fully aesthetic values. For example, I've asked a number of them what it's worth in dollars and cents for an individual to be able to see the Grand Canyon in all of its majesty. That argument took place during discussion on the air quality standards that were set nationally when Congress was considering authorizing a series of coal-fired electric plants adjacent to the Grand Canyon. Even when construction applied the most up-to-date air pollution abatement technology, the area was destined to become so dirty that you couldn't see the Grand Canyon. In order to really see the Grand Canyon you must be able to see for 50 to 100 miles.

The real question is, What's it worth to an individual to be able to see the Grand Canyon? Economists to a man will throw up their hands and say there's no way we can place a dollar figure on aesthetics. So we're left with the concept that on some of those national treasures like the Grand Canyon the only thing is to say, regardless of the costs, we're not going to pollute the air, we're not going to impair the quality of the air to the extent that the public is unable to see one of the great wonders of the world. Those generating plants around the Grand Canyon were moved somewhere else because of the public outcry of what might have happened there and because the economists were not able to put a dollar and cents value on it.

What is a fish worth? That's another question that comes up before the economists. And to most economists the value is what a fish can be sold for in the fishmarket. That value, however, does not represent the true value of that fish when pursued and caught by a recreational fisherman.

That same fish sold by a commercial fisherman to the fishmarket for 40 cents a pound is worth \$40 to \$50 a pound to the recreational fisherman. In fact, if some of you fishermen's wives really knew what it cost to bring those few fish you catch home, you'd have a rough time going as often as you'd like to go.

That cost does not reflect the personal pleasure or the aesthetic values that you have experienced in going fishing. And those aesthetic values, the incomparable joy so many individuals seek and find in communion with nature, simply cannot be measured in dollars and cents. Yet we must develop a method of attaching the true value to those aesthetics that contribute so much towards what most of us refer to as the quality of life.

Most people move into large urban areas like Los Angeles to earn a living, and then what do they do when they get a little money and some time off? They always go to the mountains, to the streams or lakes, to some area where they can participate in activities in a relatively undisturbed natural setting that contributes to the quality of their lives.

In sum, if Californians could be thus informed fully of the values to be achieved, that those who use must pay, and that the overall public interest

therefore is best served by the construction of the Peripheral Canal in California, then our great state would continue to enjoy its reputation as the Golden State. Thank you.

Questions Addressed to Mr. Kimball

AUDIENCE PARTICIPANT: I am a little confused. In my own area which I know well, which is the terminal rain in glacial area, wetlands are discharge areas, not recharge areas. Is this a generality that is true, or is there a misapprehension, perhaps, that saving the wetlands helps groundwater recharge?

MR. KIMBALL: It depends on where they're located. You take Florida, for example. It's a very porous, sandy, limestone area and in certain areas the water just sinks down like a sponge, and in that essence it contributes very much to the groundwater area. It's a water recharge area. You don't get it -- in fact, that's what's happening as was explained in the film. They are pumping fresh water faster than the aquifer can be recharged and in order to fill that cavity you've got intrusions of saltwater from the ocean, and that's not very good to drink.

Other areas where you get some impervious types of soils beneath the wetlands could become discharge areas. They're not going anywhere, they're just running off.

AUDIENCE PARTICIPANT: That's our condition north of this state.

MR. KIMBALL: That's what Robert Frost once said about America, that a great nation in the beginning is a good chunk of real estate and we've got such a variety here that you can't take one thing and apply it to the whole country. Like out West you have the Prior Appropriation doctrine of water, "first in use is the first in right," and no riparian rights at all. If you don't have an actual deed to the water that you used back in 1800, you don't get any.

AUDIENCE PARTICIPANT: We have that at home, we call it "first up is best dressed."

AUDIENCE PARTICIPANT: Do you feel very strongly that the Peripheral Canal will prevent more environmental problems that it will cause?

MR. KIMBALL: No, it will cause environmental problems, but it will be better than using the current diversion and continuing the increase in the diversion through those current diversion sites. There's a difference among some environmentalists who say we shouldn't have any more diversions. They go along with the Northern Californians and say, "Let's just stop it and not have any more diversions of water." But to me that's not politically realistic. You have people from the industrial Northeast and mid-section of the country who are flocking now to the Sunbelt and a lot of them into Southern California. Those people buy homes, they have to have water in them and

they're going to have it. The only question is, How can you minimize those adverse impacts and enhance where you can?

That's the conclusion most informed people came to when the legislature proposed Proposition 8 to the voters. That that's what it would do. The only problem was it costs \$5 billion and the question was who was to pay for it. Most others were confused, and as a consequence, it went down the tube. The voters didn't really fully understand it.

AUDIENCE PARTICIPANT: What is the role of the Coastal Commission, particularly related to water plans?

MR. KIMBALL: You mean in California? Well, the Coastal Commission has very broad powers in California. You can't develop anything along the coast now unless it's passed on by the Coastal Commission. And they're approving very few developments. The reason for that is that about 90 percent of the coastal marshes are gone on the coast, along the coast of California, so when an application comes in to develop another marina or a line of condominiums to look at the ocean on a coastal wetland, the obvious answer is, "No, you can't do that." That has caused considerable concern and political pulling and hauling between development people who want to develop and put houses or condominiums or industrial sites all along the coast which would destroy the pitifully small remnants of coastal wetlands. The Coastal Commission has that authority given to it by the legislature to make those kinds of decisions.

CHANGING CLIMATE: ITS EFFECT ON WATER RESOURCES PLANNING

Stanley A. Changnon, Chief
Illinois State Water Survey, ENR

In addressing climate change, I have focused on Illinois and on the forces affecting competition for water, identified as nature and man. The two prior papers have largely addressed the subject of man's influence on competition for water. I have focused largely on those changing natural forces that affect competition. These are largely reflected in our climate.

Climate is the basic controlling factor in determining the quantity of water in Illinois, both at the surface and in the ground. As climate fluctuates, it has a direct effect on these quantities and to some extent on the quality of our waters.

If climate changes, it can bring increased or decreased competition for water. We can have too little water or we can have too much of the wrong kind of water as the result of climate forcing.

I wish to address four questions: Is the climate changing? And since the answer to that is yes, In what ways is it changing? How are these changes affecting us? and What are some of the options in water resources planning to deal with these changes?

The changing climate is one of the 11 emerging issues identified in the 1981 State Water Plan for Illinois. Climate is always fluctuating on various time scales ranging from years to decades and to centuries, and there are two changes involved.

One change relates to the long-term trends, defined as those lasting for decades or longer. Climate is always tending to become warmer or cooler, or wetter or drier. Today, Illinois is in a cooling period that is some 40 years long and also in a 20-year wet period.

The second aspect of climate change, and one that is equally important to water resources, is the degree of variability around these long-term trends. Is variability getting less or greater? During the 1950s, the climate extremes of Illinois became less and remained less until the early 1970s. The question is, How much is variability changing in Illinois?

Figure 1 is a 140-year record of the mean temperatures of Illinois. One notes nearly 100 years of general warming to the peak of the 1930s, and since then 40 years of cooling. If you go horizontally across the graph from 1980, one finds that the temperatures in Illinois now are approximately what our grandparents were experiencing in the 1880s and 1890s. It's getting cooler.

Precipitation for the same 140 years, 1840-1980 (Figure 1), does not show only two trends as did temperatures. Precipitation over the past 140 years exhibits several ups and downs, a "climatic seesaw." We are in a relatively wet period now.

An important aspect of these trends relates to summer rainfall. Table 1 presents, for each decade since 1899, the number of growing seasons that have been classed as wet or dry in the state. A key point to agricultural interests is that the 1970s had six wet growing seasons and only one dry one. Summers have been wetter more often. Table 2 relates to Urbana which is typical of any location in Illinois. The July and August rainfall values, which are very critical to the state's agriculture and water supplies, show that in the recent five years, we have been averaging 5.1 inches of rain in July and 6.7 inches in August, compared to historical (1889-1970) averages of around 3.3 inches. It has been very wet in Illinois in recent summers.

However, the variability of rainfall has been changing at the same time. One might ask, How can it get wetter and also get more variable? Here is an example. Figure 2 presents, in the length of the bars, the amount of area in Illinois that has had less than half of its normal July and August rainfall in each year since 1930. Such deficiencies are indicative of summer droughts. In the 1930s and 1940s, dry areas were often extensive, but in the 1955-1973 period there were few extensive summer dry periods. However, since 1974, one notes a greater frequency of areas of more deficient rainfall in the summer, but also coupled with several extremely wet summers such as in 1980 and 1981.

Another example of shifts in rain extremes appears in Figure 3. The decadal frequencies of heavy rain days, both for the warm season and for July-August, show a recent maximization. The values for 1971-80 are the peak for this century.

Examination of droughts during 1906-1981 in Illinois shows frequent droughts in the 1906-1956 period. None occurred in Illinois during 1957-1975, but these two in the 1976-1981 period. There is a suggestion that droughts are returning.

I do not wish to address at length the anthropogenic effects on the Illinois climate, but two influences are evident and important in Illinois. Our extensive studies at St. Louis and Chicago pointed to the fact that both in and east of these cities, there have been sizable, 10 to 30 percent, increases in summer rainfall (Figure 4). These have included 50 percent increases in heavy rainfall rates and in the number of heavy rainstorms. These are related to urban influences on rain-producing conditions. These have changed the rainfall climate in these areas.

Another important example of accidental climate modification relates to jet-produced contrails since 1960 and their effect on cloudiness and temperatures, which in turn influence evaporation and water use. Historical cloud records since 1900 show that in the late 1930s and 1940s there was a major increase in Illinois in the number of cloudy days. Since 1960, the state has experienced a further increase so we now have a cloudier climate, partly man-affected. Contrails apparently have increased cloud cover by 10 to 20 percent.

Figure 5 presents the January temperature graph for Peoria. This reveals that the Januarys in the last few years have been very cold in Illinois. The important point here is that when it is extremely cold, we have more snow and we have rivers frozen with ice jams, and in turn, more floods. Also recall,

Table 1. Decadal Frequency of Wet and Dry Growing Seasons
(May-August) in Illinois, 1900-1979

	<u>Number of Wet* Seasons</u>	<u>Number of Dry** Seasons</u>
1900-1909	3	3
1910-1919	3	5
1920-1929	3	3
1930-1939	1	6
1940-1949	6	0
1950-1959	1	3
1960-1969	3	5
1970-1979	6	1

* Wet represents upper 1/3 of rainfall values.

** Dry represents lower 1/3 of rainfall values.

Table 2. Recent Summer Climate Conditions at Urbana, Illinois

	<u>Temperature</u>			<u>Rainfall</u>	
	<u>Jul</u>	<u>Aug</u>		<u>Jul</u>	<u>Aug</u>
Recent 10 years (1972-81)	75.1°F	72.9°F	Recent 10 years (1972-81)	4.78"	5.69"
Recent 5 years (1977-81)	75.1°F	72.9°F	Recent 5 years (1977-81)	5.10"	6.71"
Long Average (1889-70)	74.5°F	73.5°F	Long Average (1889-70)	3.37"	3.21"
5-year Difference	+0.6°F	-0.6°F	5-year Difference	+1.73"	+3.50"

Illinois has been having (in 1971-1980) record high numbers of heavy rain days (Figure 3). These recent climate changes could and do impact on flood frequencies. Figure 6 presents the decadal numbers of flood days occurring on two rivers, the Rock River and the Sangamon River. Most other rivers in Illinois show similar fluctuations with peak values of their 60-year records for floods during the last 10 years. Yes, recent climate changes have increased flooding in Illinois.

Interestingly, we have recently experienced serious impacts from too little precipitation in Illinois. Figure 7 is a collage of headlines from the drought of 1980-81. This drought, although not one of the state's serious droughts from a low precipitation and runoff standpoint, brought new concern about droughts. One illustration of the local problems appears in Figure 8. This graph plots, from November 1980 through May 1981, the number of days of water remaining in the Eldorado city reservoir. Also shown are the series of remedial actions that were being taken during the drought. Lack of local experience with droughts, related to the 20 years without droughts in Illinois, was evident in many of the hurried decisions, and in the lack of proper maintenance of the water system in recent years. There had been a growth in water use and this was not recognized. The Eldorado reservoir and many other city reservoirs have lost capacity by siltation. Another drought impact was a reawakening of concern that affected the State Water Plan Task Force. It identified the need for drought contingency planning in Illinois as a major issue.

In summary, the precipitation climate of Illinois has changed sufficiently in the last 10 years, particularly in its extremes (wet and dry), that the changes are significantly impacting water supplies, droughts and floods. Since Illinois is going to be dealing in the immediate future with a climate that is different than what it has been for most of the last 60 years, we are and will be experiencing events that some of our water systems were neither designed for nor are adequately developed to handle.

Proper assessment of the current climate shifts, including the wet and cooler trends and the increases in the variability of the climate from year to year and particularly in extremes of weather, is integral to wise planning and the management of water in Illinois. Climate's effect on the state's water resources is easily visualized by the recent dramatic increases in both floods and droughts. Figure 9 shows how climate shifts can have a profound effect on water resources and our state institutions. Changes to more extremes are of singular consequence to the state's economy and to its water management institutions.

The means by which state and local government entities can react to and plan for future climate extremes fall into three classes. One of these is reduced and delayed services and more difficult and expensive management. I would label this "reactionary planning."

The second approach allows an excess for planning and for budgeting of personnel and resources to handle the climate unknowns. This is "surplus planning."

The third approach integrates what is known about climate changes and integrates climate predictions. This is a "climate planning" approach.

Developments of climate predictions, by the Water Survey and other groups, have established useful skill to predict precipitation classes (above normal, near normal or below normal) for months and seasons ahead. An example of the predictions issues at the end of September 1982, for four parts of Illinois, appears in Table 3. It shows the probabilities for October precipitation and those for the fall 1982 and winter 1982-83. Such predictions have been issued routinely by the Water Survey for more than two years. Importantly, they have been correct about 60 percent of the time, and they correctly predicted the end of the 1980-81 drought and the onset of the 1981-82 extremely wet periods. Early detection of these extremes is of great pertinence in water resource operations.

The 1981-82 State Water Plan defined climate change as one of 11 major water issues in Illinois. The Plan made four recommendations relating to climate changes and water resources.

One recommendation is to develop better public awareness of the fact that the climate change is occurring and is a problem for water resources. Illinois needs a more ambitious program of education and information assistance about climate to make the public and decision makers more aware of the climate problem.

The second recommendation for Illinois is to maintain climate monitoring and research efforts. One of the actions that the Water Survey has taken, partially as a result of the fact that the federal government is reducing climate data collection and monitoring efforts in Illinois, was to establish in 1981 a benchmark network of 14 climate stations in Illinois. These are now in operation but future support must be found. The key point is that Illinois cannot definitely describe nor address climate change without a commitment to data collection of a very high quality. Illinois must make that commitment.

A third recommendation is to provide to water interests and other users, easier, cheaper and more rapid access to climate data, climate information and our predictions of climate. The Water Survey has just received federal funding to initiate a climate demonstration project. We will provide, in real time, continuous presentations of updated climate information and predictions to selected users, including state agencies and certain industries.

The fourth recommendation calls for the development of state and local plans to address climate extremes. The State Water Plan Task Force identified, as one of the 11 issues, development of a statewide drought contingency plan. A Climate Detection and Advisory Board with members from state water agencies is needed to monitor climate conditions and to issue warnings for extremes.

When I was in Eldorado during the height of the 1980-81 drought there, one of the residents described the acute water shortage by saying, "You really can't blame anyone; everyone is to blame. We took our water for granted until it ran out."

Illinois should plan, inform, act and manage those facets of our water systems so as to wisely react to the changing climate. The existing climate shifts will affect the quantity of water more than the quality of our water.

Table 3. Precipitation Outlooks for Illinois
Issued on September 30, 1982

<u>Areas</u>	<u>October 1982</u>		<u>Fall 1982 (Sept.-Nov.)</u>	<u>Winter 1982 (Dec.-Feb.)</u>
Northern(1)	Below Normal	30%	Above Normal	Near Normal
	Near Normal	40%		
	Above Normal	30%		
North Central(1)	Below Normal	50%	Near Normal	Below Normal
	Near Normal	20%		
	Above Normal	30%		
South Central(1)	Below Normal	25%	Near Normal	Below Normal
	Near Normal	30%		
	Above Normal	45%		
Southern(1)	Below Normal	50%	Near Normal	Below Normal
	Near Normal	20%		
	Above Normal	30%		
<u>Values (inches)</u>				
Normals				
Northern	2.5	(+0.6)	7.4	(+1.5)
Central	2.7	(+0.5)	8.3	(+1.8)
South Central	2.9	(+0.6)	8.9	(+2.0)
Southern	3.1	(+0.7)	9.8	(+2.0)
			9.3	(+1.4)

(1) Northern = northwest and northeast crop districts; Central = west, central and east central districts; South Central = west-southwest districts and east-southeast; Southern = southwest and southeast crop districts.

One very certain climate prediction is that Illinois will have dry lake beds in the future. Serious droughts will heighten the competition for our water resources.

As a result of our assessments which show an increase in floods and droughts, it is clear that Illinois should be better informed and have organized local and state programs for addressing climate-induced extremes. The state's drought contingency planning effort, the Water Survey's climate predictions, and our real-time climate data center demonstration program are examples of needed programs. This climate awareness and action program has to be continual so as to involve recognition of changing lifestyles, uses of water and other new technologies that are climate impacted.

Questions Addressed to Mr. Changnon

AUDIENCE PARTICIPANT: I'd like for Stan to comment on the future of cloud seeding.

MR. CHANGNON: Well, it is one of those new technologies that is addressed in the State Water Plan. As some of you know, cloud seeding has been used in the last several years in Illinois in attempts to increase summer rainfall in Southern and Central Illinois. The technology is not well developed. It needs development. It needs research. Tom Kimball and I spent approximately two years of our lives on the Congressional Advisory Board for Weather Modification. The Board's primary recommendation was that the nation needs an ambitious R and D program in weather modification, but at this time the federal program is at its lowest ebb in 20 years. So we weren't very effective salespersons.

But it's an emerging technology. Some places in the country, I perceive, you can modify the weather. In Illinois it's still a gamble.

AUDIENCE PARTICIPANT: Are the Water Survey Division and climate people working with agriculture in any way to develop more permanent sustaining crop programs to handle the changes in the weather?

MR. CHANGNON: We work with everyone who has a desire for data and information. If you will look at several of our publications on display, on the table outside, you'll find quite a few of them related to weather and water for agriculture. We have spent considerable time in recent years studying the weather and water relationships to erosion, crop yield, irrigation and weather modification. We focused on the maximization of crop yields which is one of the long-term goals of society. More water will sustain higher yields in Illinois.

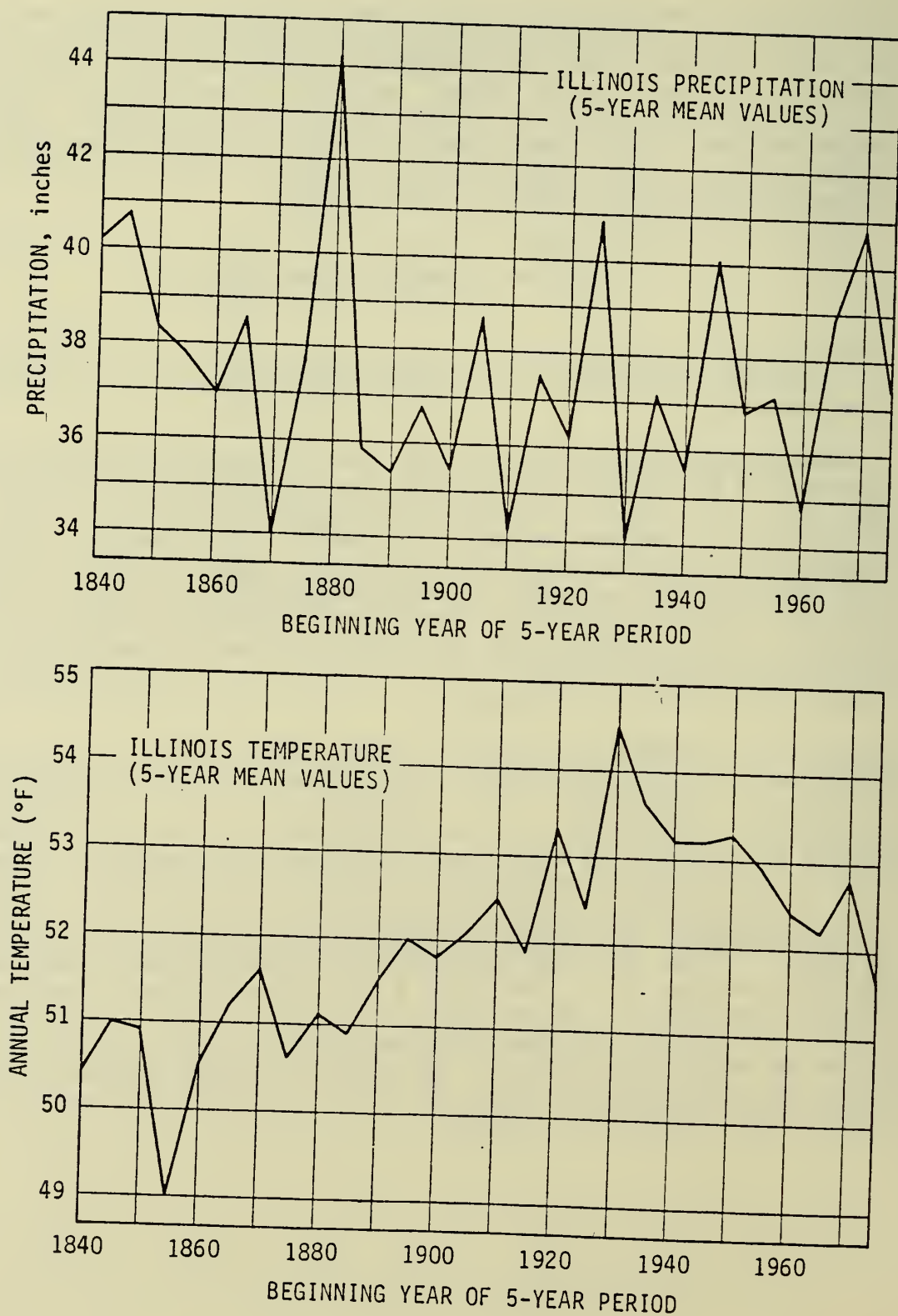


Figure 1. Annual Mean Temperature and Precipitation values for Illinois, based on 5-year periods, for 1840-1980.

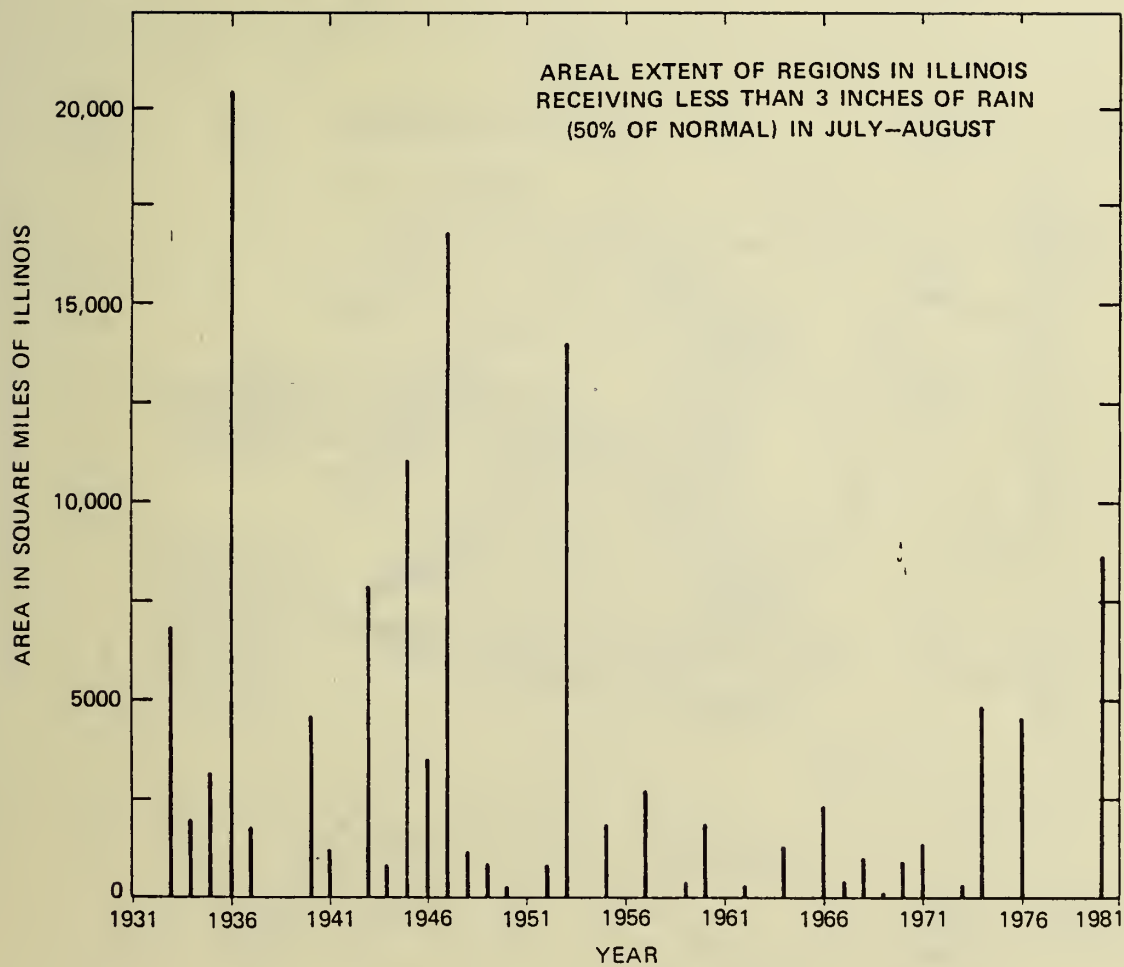


Figure 2. Extent of areas of Illinois where July plus August rainfall was 50% or less than normal for 1931-1980.

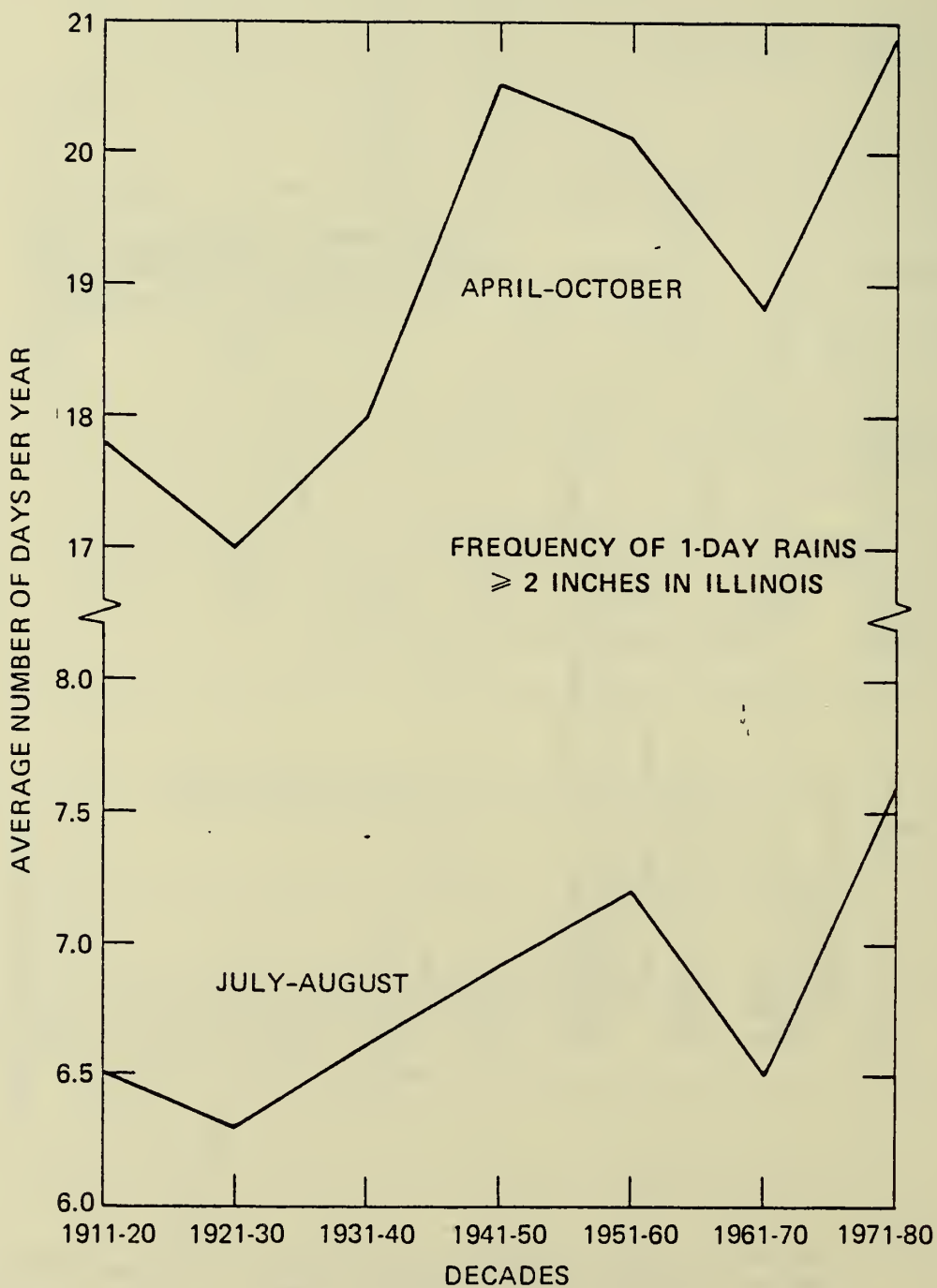


Figure 3. Frequency of days with 2 inches or more rainfall in Illinois, 1901-1980.

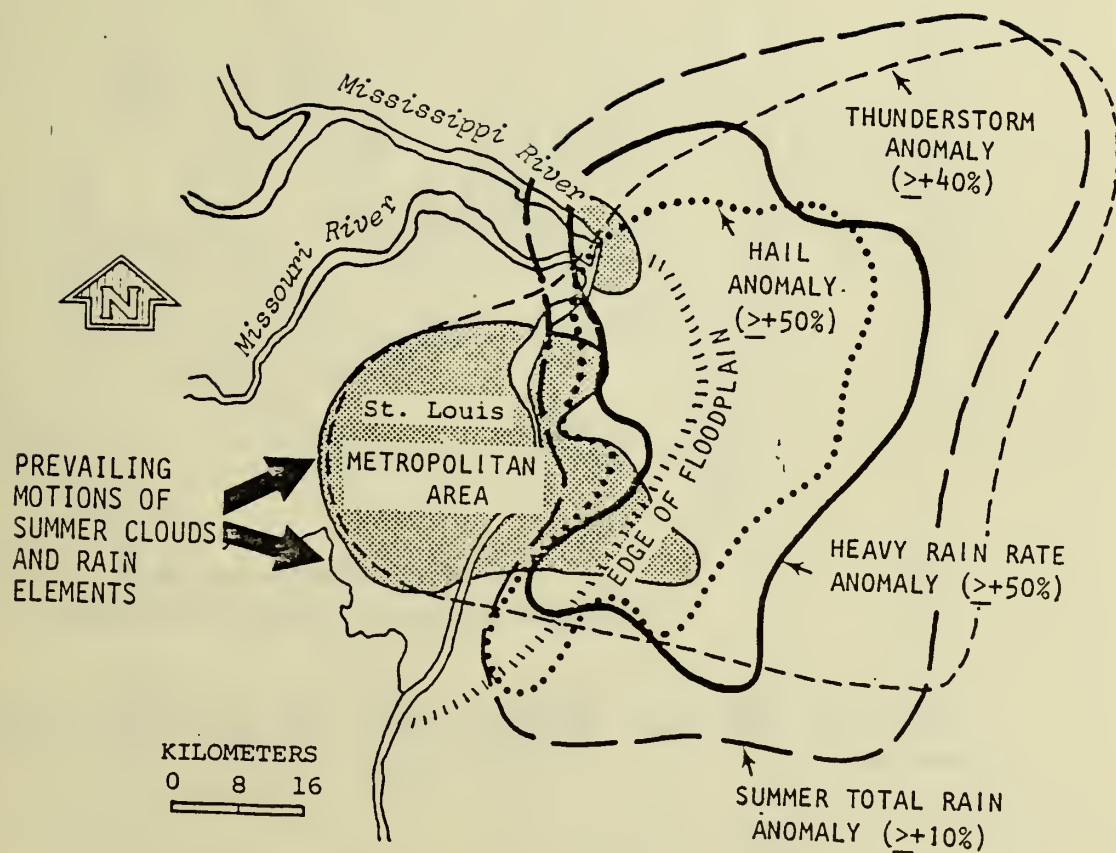


Figure 4. The climate anomalies found in summer rain and storms, caused by St. Louis.

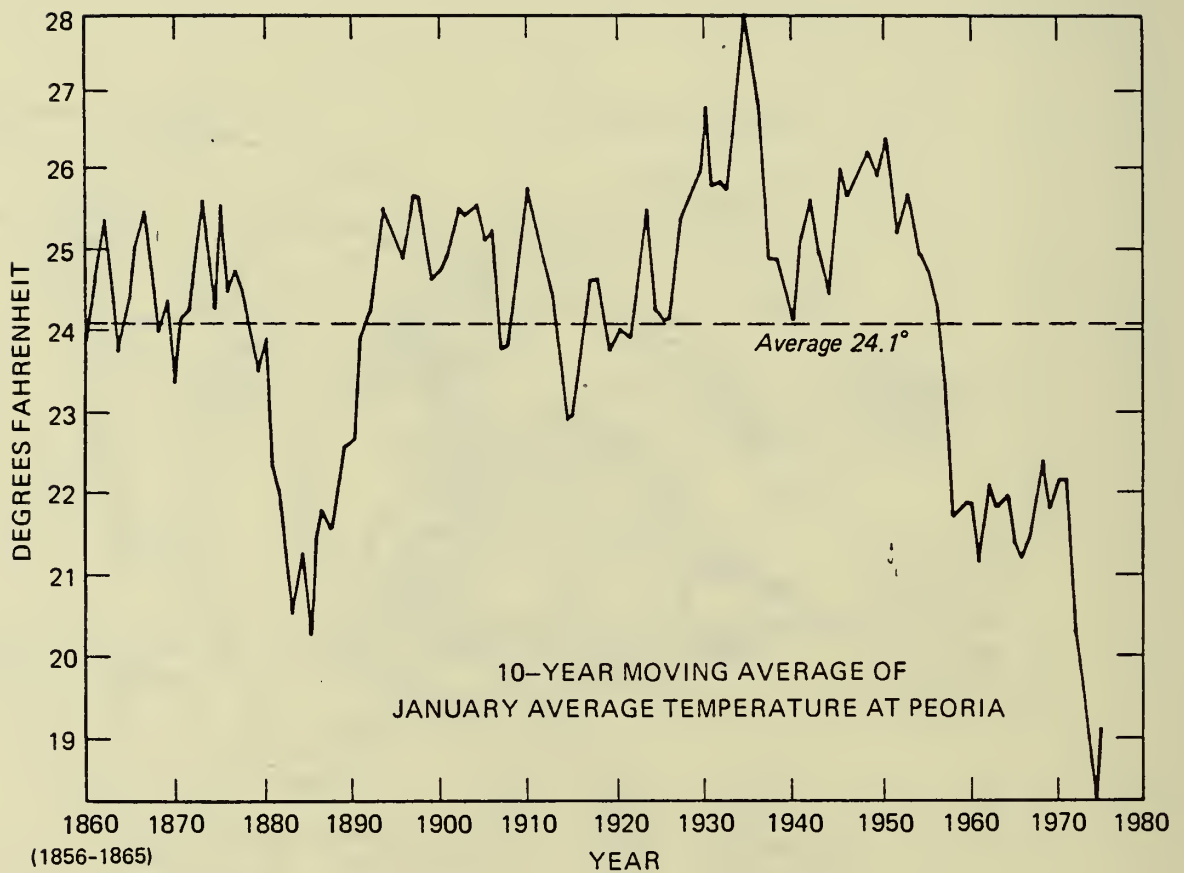


Figure 5. January temperature values at Peoria for 1856-1980.

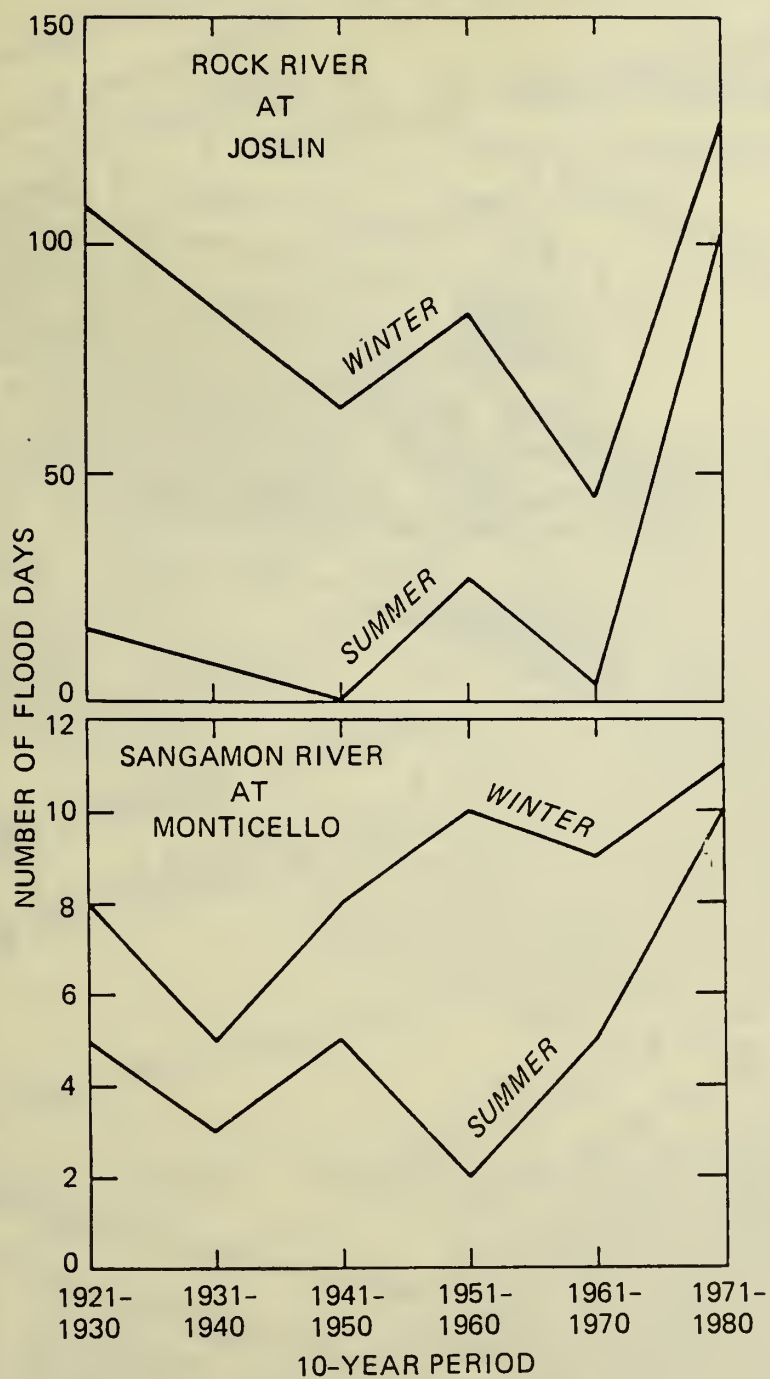


Figure 6. Frequency of days with floods on the Rock River and Sangamon River, 1921-80.

Coulterville Officials Declare Water Emergency

Experts offer strategies for coping with Marion city reservoir droughts; council eyes

Above-Normal Rainfall Preserves Moisture Levels Remain Low

By Jeff Stroud
Of the Press-Dispatch Staff

It rained, but not enough to make up for the moisture deficit which the drought has caused in Southern Illinois, say experts. The drought has caused a moisture deficit of about 10 inches in the Marion city reservoir, which is the main source of water for the city. The drought has also caused a moisture deficit of about 10 inches in the surrounding area. The drought has caused a moisture deficit of about 10 inches in the surrounding area. The drought has caused a moisture deficit of about 10 inches in the surrounding area.

Dry soil periling Illinois crops

Carlisle Lake continues at dangerously low water level

by Becky Merrell
Carlisle Lake's water level
reflected a \$2.4 million referendum
last week's election

disagreement by the City Council
brought the issue to a vote

Drought widens land price range

URBANA (UPI) - The range of prices for Illinois farmland has widened in the last year, with the lowest values in areas hardest hit by the heat and drought of 1980, a University of Illinois specialist says.



Four days of heavy rain and the lake was filled to eight inches of the spillway. On August 10, 1980, water finally pumped into Carlisle Lake. The lake's water level was 5.77 feet above the level of the lake at the time of the referendum. The lake's water level was 5.77 feet above the level of the lake at the time of the referendum. The lake's water level was 5.77 feet above the level of the lake at the time of the referendum.

Illinois' arid 'Little Egypt' thirsty for rain and snow

Water shortages in the Illinois State Water Survey's report on the drought. The report says that the drought has caused a moisture deficit of about 10 inches in the Marion city reservoir, which is the main source of water for the city. The drought has also caused a moisture deficit of about 10 inches in the surrounding area. The drought has caused a moisture deficit of about 10 inches in the surrounding area. The drought has caused a moisture deficit of about 10 inches in the surrounding area.

Farmer Charley Ludwig examining the dry soil on his 300-acre farm west of Springfield. The drought has caused a moisture deficit of about 10 inches in the Marion city reservoir, which is the main source of water for the city. The drought has also caused a moisture deficit of about 10 inches in the surrounding area. The drought has caused a moisture deficit of about 10 inches in the surrounding area. The drought has caused a moisture deficit of about 10 inches in the surrounding area.

Persistent wino dustout conditions in... The drought has caused a moisture deficit of about 10 inches in the Marion city reservoir, which is the main source of water for the city. The drought has also caused a moisture deficit of about 10 inches in the surrounding area. The drought has caused a moisture deficit of about 10 inches in the surrounding area. The drought has caused a moisture deficit of about 10 inches in the surrounding area.

Farm, urban residents feel effects of drought

Centralia Officials Issue Water Shortage Alert

Centralia, Ill. (AP) - Centralia officials issued a water shortage alert today because of the drought. The drought has caused a moisture deficit of about 10 inches in the Marion city reservoir, which is the main source of water for the city. The drought has also caused a moisture deficit of about 10 inches in the surrounding area. The drought has caused a moisture deficit of about 10 inches in the surrounding area. The drought has caused a moisture deficit of about 10 inches in the surrounding area.

at the special meeting agreed... The drought has caused a moisture deficit of about 10 inches in the Marion city reservoir, which is the main source of water for the city. The drought has also caused a moisture deficit of about 10 inches in the surrounding area. The drought has caused a moisture deficit of about 10 inches in the surrounding area. The drought has caused a moisture deficit of about 10 inches in the surrounding area.

Cedar Lake: A beach but not enough water

Stanley Changman, chief of the Illinois Water Survey, said drought conditions based on current weather predictions, could affect communities located below a late extending from Quincy to Kankakee.

Thompson called the task force 'just one part of our overall state effort to promote water conservation, which is absolutely essential for our continued economic development as well as the health and safety of Illinois citizens.'

Low rain totals near 'frightening'

By SIU-C News Service
And The Southern Illinoisan

Thompson names downstate drought task force

SPRINGFIELD, Ill. (UPI) - Water shortage in central and southern Illinois has prompted Gov. James R. Thompson to name a drought task force. The drought has caused a moisture deficit of about 10 inches in the Marion city reservoir, which is the main source of water for the city. The drought has also caused a moisture deficit of about 10 inches in the surrounding area. The drought has caused a moisture deficit of about 10 inches in the surrounding area. The drought has caused a moisture deficit of about 10 inches in the surrounding area.

Harrisburg to Use Pump To Ease Water Shortage

The Harrisburg Water Board has approved a plan to use a pump to bring water from the Mississippi River to the city. The drought has caused a moisture deficit of about 10 inches in the Marion city reservoir, which is the main source of water for the city. The drought has also caused a moisture deficit of about 10 inches in the surrounding area. The drought has caused a moisture deficit of about 10 inches in the surrounding area. The drought has caused a moisture deficit of about 10 inches in the surrounding area.

Drought at crisis

The drought has caused a moisture deficit of about 10 inches in the Marion city reservoir, which is the main source of water for the city. The drought has also caused a moisture deficit of about 10 inches in the surrounding area. The drought has caused a moisture deficit of about 10 inches in the surrounding area. The drought has caused a moisture deficit of about 10 inches in the surrounding area.

Figure 7. Collage of headlines on impacts of the drought: Jan. 26, 1981

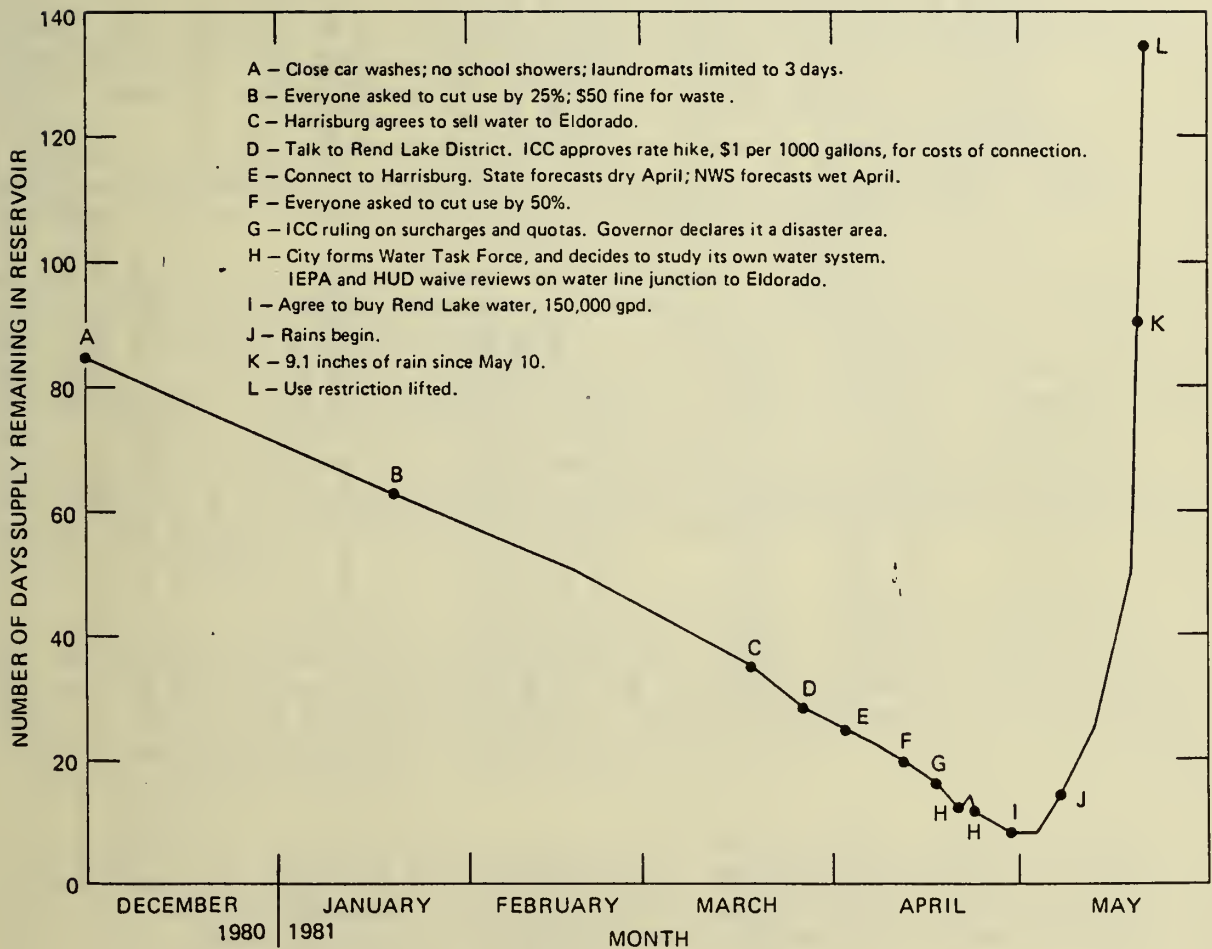


Figure 8. Graph depicting amount of water remaining at Eldorado in 1980-81 drought, and some of the local and state activities to get more water or to reduce consumption

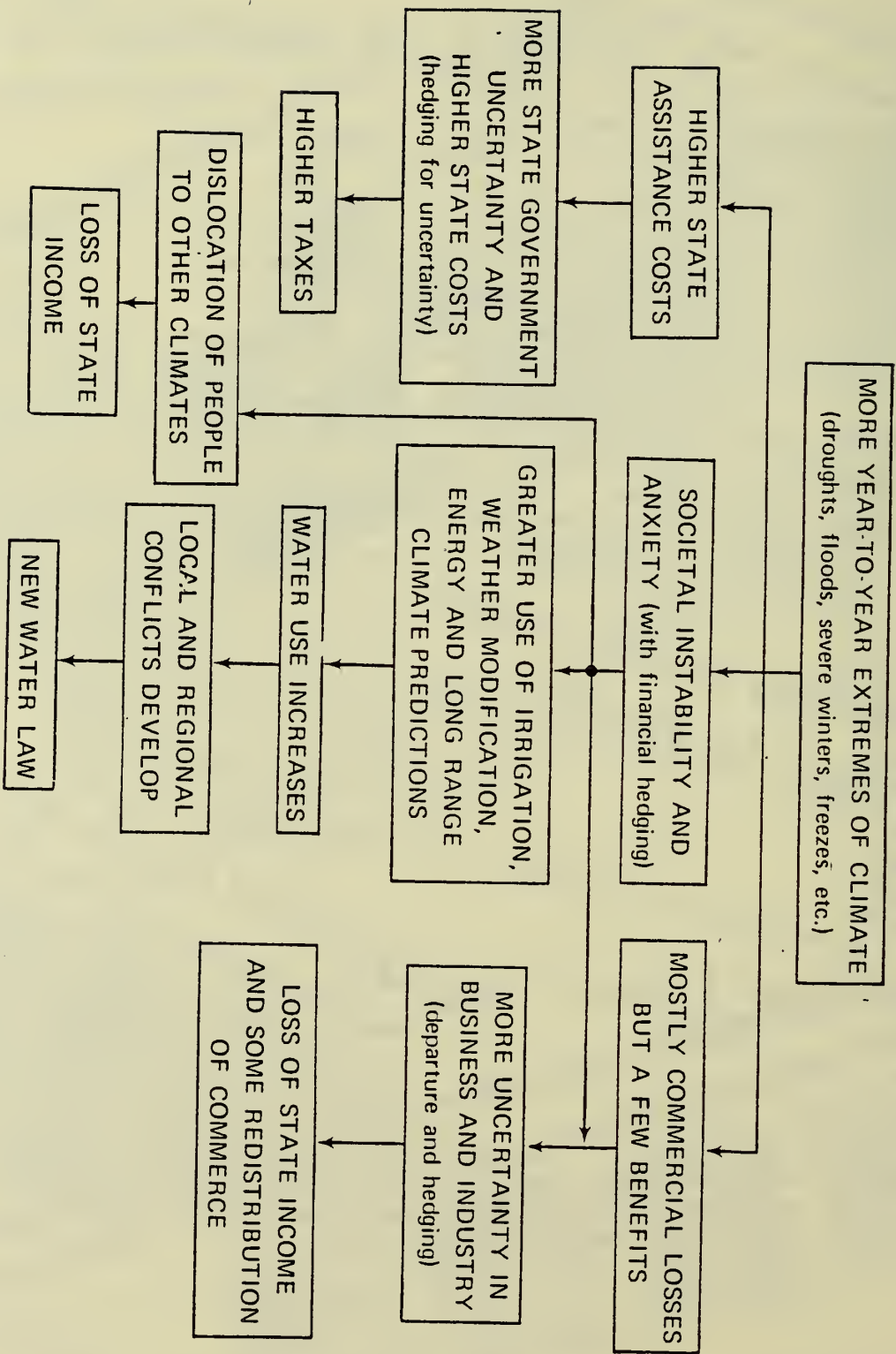


Figure 9. Some of the impacts and possible outcomes of additional short-term climate changes in Illinois.

KEYNOTE ADDRESS

Barry Commoner, Director
Center for the Biology of Natural Systems,
Queens College

Thank you. I'm really honored to be invited to come back to the State of Illinois. When I was in Missouri, I discovered that if you were concerned with any environmental problems on the administrative level you pretty well had to cross the river to Illinois. Missouri sort of forgot, still has forgotten, that there's an environment to deal with. I've always had excellent cooperation and have been always delighted to work with this state, so I'm really happy to be back here.

I thought it would be important, since I'm giving you the keynote in the middle of a conference, to reflect on the changing situation with respect to resources and environmental quality, particularly in our water resource.

As you know, the country has been in the process of a good deal of change since the new Administration came in. I thought I'd take as the text for my sermon a statement made by Mr. Reagan in his letter of introduction to the last report - in fact first report - under his Administration of the Council on Environmental Quality, which as you know is required by law to report each year to Congress on the state of the environment. In his letter Mr. Reagan said, "Working together we can make the necessary changes to reach our environmental goals and at the same time use our resources wisely with the help of the free market. As we do we will create a healthful environment and a healthy economy."

The reason for reading that is to remind you that the present operation of our environmental agencies, particularly EPA, is very closely linked to the economic goals of the Administration. And we can't separate the two, so I'm going to accept the challenge of dealing with the improvement in the quality in the environment, particularly the water environment, and doing it in a way which improves the economy.

A good way to start is to examine the recent trends in water quality in the United States and see what's been happening. In the last decade with the sharp rise in environmental concern, new laws have been enacted and extensive efforts have been made to improve water quality. I'm sure a good deal of that's being discussed here at the conference.

In 1973 alone, for example, government agencies spent \$5.4 billion and private industries \$2 billion on efforts to control water pollution. That figure has increased ever since then until recently.

As I pointed out, the Council on Environmental Quality has the task of reporting trends in environmental quality and the report comes out every year. I was interested in the effect of the new Administration on this task. I might report to you that in some sense there's been a drastic improvement in the environment since Mr. Reagan came into office, because I compared the

CEQ report put out under his aegis (that's the 1981 report I guess) with the last one under Mr. Carter's aegis, and I discovered that the number of words in the report was cut from 195,000 to 63,000. Apparently there's not as much to report about environmental pollution as there was.

I should say that the two books were about as thick, but for some reason Mr. Reagan's Administration believes in using very wide margins and large type. We can worry about the efficiency of the use of the paper later on.

So the report I'm going to give you about trends in the environment is pre-Reagan. In fact I checked the reports, the tables in the Reagan report, and found that they were mostly reorganized versions of earlier tables.

What I'm trying to tell you is CEQ hasn't been working much lately. At any rate, the old report tells that there have been improvements in water quality. The number of waterways, for example, for which ammonia levels exceeded the allowable standard was reduced from an average of 16 percent in 1963 through '72 to an average of 6 percent in '68. After 1968 there have been improvements in 76 percent of the nation's waterways with respect to ammonia levels in that period.

A similar trend has been observed with respect to dissolved oxygen, so those two very basic indicators of the state of the ecological cycle in water have improved. However, there are other indices of water quality and they haven't improved.

In particular, the number of waterways in which nitrate concentrations exceeded the allowable limit doubled in that period of time. And only 26 percent of the waterways showed any improvement with respect to nitrate level.

Phosphate content showed a similar worsening trend. What we see in the period since EPA came into being and there were efforts to improve water quality is that two indicators, ammonia and oxygen, have improved. Two other indicators, nitrates and phosphates, have gone the other way.

I was, I was going to say, happy to learn - but it's sad, I should tell you - that the Sangamon River's high levels of nitrate in the spring are still with us. I didn't know it but I consulted with Stanley Changnon a few minutes ago and he tells me that the levels are still up there. The reason why I was happy to learn it is that I'm going to discuss that problem and I was a little worried, when I walked in the room, that for some reason the State of Illinois had managed to get all the nitrate out of the water and my argument had disappeared.

But as I say, fortunately for me, unfortunately for other people, the nitrate is still there.

This is an old problem. If I remember correctly I had a call from the Public Health Director of the City of Decatur some time around in the early 1950s because he was worried that the nitrate levels in the drinking water in Decatur, which came from the Sangamon River, in the spring exceeded the

Public Health Service limits. This is an old story and it's important to examine it and see where it comes from and how we can follow Mr. Reagan's mandate to revise our approach to this problem in a way that deals both with environmental quality and economic improvement.

To understand this problem we've got to take a look at the ecological cycle that's involved. I just want to remind you of what most of you know, that in the soil there is an ecological cycle that has a great deal to do with the character of groundwater and surface waters. The plants, the crops, take inorganic nutrients out of the soil and at the same time carbon dioxide from the air. Using the sun's energy, they synthesize organic compounds of various kinds. Those organic compounds are used by animals of various kinds as food. The animals produce organic matter in the form of waste which in the natural cycle falls on the ground, and a whole variety of microorganisms incorporate that into the chemistry of the soil, generally building up the complex carbon and nitrogenous matters in humus. The humus is gradually broken down by other bacteria so that nutrients such as nitrates appear gradually in the soil. This is taken up by the roots of the crop and the cycle is maintained.

It's clear that in nature - let's say the prairie in the Midwest - this cycle maintained a very low level of nitrate in the soil and the rain did not wash much nitrate out into the rivers so that generally one part per million nitrate nitrogen was characteristic of an unaffected river in this part of the country.

Now things have changed. In the first place, the cycle has been broken. Instead of the organic matter in the form of animals and animal waste being deposited in the soil, we ship food to cities and you can think of cities as a big machine for turning food into sewage.

That's one of the things that happens. That sewage is then disposed of by being treated in various ways and entering surface waters elsewhere. The important thing, from the point of view of this area, is that the nutrients present in the food do not get back to the soil and the result is that the fertility of the soil drops. The natural fertility of soil in the Midwest is down by about 50 percent as compared with the 1880s when agriculture first started.

In other words, simply by creating cities, breaking the natural cycle, we have had an effect on the fertility of soil. That's been handled, though, by putting artificial nutrients, particularly nitrogen, but also phosphate and potassium, on the soil in the form of fertilizers.

That's what's been happening, basically, in this part of the country since World War II. One of the astonishing things is this. We're accustomed to thinking that agriculture is totally dependent on the heavy use of fertilizer. If you go back and look at the statistics you'll find that very little fertilizer was used before World War II and it's only since World War II that there has been a very big increase in the use of fertilizer in this part of the country. What that's done is to increase the yields of corn and soybeans and that has had a good deal to do with the economy. Remember, we have to talk about that with the economy of this part of the country.

When the center that I direct was still located in St. Louis, we did a series of studies on this problem. In fact, the reason for it was the phone call that I got from the Director of Public Health in the City of Decatur who was worried about high nitrate levels. We began a series of studies on the nitrate problem here in Illinois and eventually in other parts of the Midwest.

What we discovered was that beginning in the 1950s, rivers in Illinois and elsewhere in the Cornbelt - and the Sangamon is perhaps the outstanding example - began to get increases, especially in the spring, in nitrate concentrations.

By 1971 at some locations, and particularly along the Sangamon, the spring concentrations exceeded the 10 parts per million of nitrate nitrogen that is the level that health agencies say shouldn't be exceeded.

Let me remind you why nitrate is regarded as a health problem. There are several reasons. One that turned up first, again in the agricultural Midwest, in the 1940s, was the so-called Blue Baby Phenomena. This was the situation in which infants being raised on farms would turn blue and be on the verge of asphyxiation. They'd be brought into town to a hospital and taken care of there, and without anything happening except being brought into the hospital they turned pink again. It turned out it was nitrite in the water that they were being fed with on the farm, whereas in the city the nitrite levels were low.

Actually it was the nitrate levels, because what happens is this. Nitrate can be readily converted to nitrite. Nitrite combines with hemoglobin to prevent it from carrying oxygen and you get the blue nonoxygenated form of hemoglobin. What happens in infants is that, particularly if they're suffering from a gastric upset, the bacteria in the gut in certain circumstances can convert nitrate to nitrite and they then suffer from nitrite poisoning.

This phenomenon has turned up from time to time here in the Midwest and in other parts of the world and is one reason to worry about high nitrate levels.

Another reason is that nitrite formed in the gut can combine with amino acids to form nitrosamines and nitrosamines are powerful agents; they cause cancer, so that's another reason.

In general, public health officials are concerned about keeping nitrate levels down and that's the reason why a number of people have looked into the problem.

What we did at our center was to follow the fate of the fertilizer nitrogen because that was a change that took place concurrently with the appearance of high nitrate levels. We did have elaborate studies involving isotopes and so on which showed that a good deal of the nitrate that entered the surface waters came from the drainage ditches which drained most of the agricultural part of Illinois. In turn, that reflected the application of nitrogen fertilizer to the soil. But I don't have to go into anything as elaborate as that.

Let me simply tell you this, and I'll draw you a graph in the air (it turns out to be more reliable than slides). If we were to plot here the rate of application of nitrogen to the soil in Illinois, that is the number of pounds applied per acre each year, and this being World War II - let's say 1945 - you find a curve like this, an exponentially rising curve. It's now quite high, and if you look on the same axis at the yields from corn, you find they started out on the average about 50 bushels per acre and rose something like this.

In other words, the yield rose but the application of nitrogen rose much faster. What you discover is that in the period of time in which the rate of application was doubled, the increase in yields was only about 10 percent. In other words, the plants were saturated with fertilizer.

That period of time which is essentially since the mid-1950s is the period in which nitrate levels began to rise in the rivers. To put it very simply, the rate of application saturated the crops and saturated it to the point where a good deal of the fertilizer simply leached into the rivers. I think it's now pretty clear that the reason for the high nitrate levels, and they occur in the spring particularly because of the heavy rains, has to do a great deal with the technology of growing corn and soybeans. Soybeans are also fertilized in the Midwest.

In 1974 we were asked to do a study by the Illinois Institute of Environmental Quality (now part of ENR) to answer the question, "What reduction in application of nitrogen at what cost to farm production?" And you know how Illinois was way ahead of Mr. Reagan? They went and tied the question of environmental quality directly to the economy of the farm. They asked the question, "What reduction in nitrogen application at what cost to farm production would need to be carried out in order to keep river nitrite below the 10 parts per million level, let's say 5 percent at the time?" In other words, what would it cost us economically to get this economic being, this environmental benefit?

We did a very elaborate study county by county in Illinois and what we discovered, summarized briefly, is this: That if in the most severely affected area which is East Central Illinois where the heaviest applications occur and where the highest nitrate levels occur, if you reduced nitrate applications enough to stay below the 15 parts per million level, it would reduce corn yields about 1.1 percent and reduce the farmers' net income about 2.29 percent.

In the rest of Illinois the losses would be considerably smaller. In some regions we found that if the regulations were imposed on the amount of nitrate put on the soil which would improve environmental quality, the farmers' net income would rise. Why? Because in certain parts of Illinois more nitrate (which costs money), more nitrogen, was being put on the soil than the plants could possibly use, so that by cutting back we could actually help the economy.

The point about this is that we're dealing with a way of having a small economic cost give rise to a significant environmental improvement. That gives you some sense of the balance between the two.

What's more, another study that we did at the center which was completed a few years ago showed that farms have been operating with no application of nitrogen fertilizer. These are all organic farms. What we studied was not little hippie or amateur farms; we studied big 500-acre farms that were operating commercially just like a conventional farm. But there were small farmers in the Midwest who for various reasons have decided not to use nitrogen fertilizer - or pesticides, for that matter - and in the study which we did, we compared two groups of about 15 farms each of conventional farms and very closely matched organic farms, matched with respect to soil and operations and so on.

For five years we followed their ecological behavior and their economic results, and again, I'm very proud that I foresaw Mr. Reagan's admonition to keep the economy in mind. What we discovered was this. On the average over that five-year period, corn yields were reduced by about 8 percent and soybean yields about 5 percent on the organic farms as compared to the ones using heavy chemical applications. The organic farms made exactly the same net return-per-acre in dollars-per-acre as the conventional farms. Why? Because although they got less from their crops, they were saving an awful lot of money by not buying fertilizer and pesticides.

Let me summarize those two sets of data simply by saying that it's clear that by cutting back fairly drastically - let's say 50 percent - on the rate of application in nitrogen, we could very much reduce the level of nitrate in the water with no effect on yields or on net income and, in fact, in many cases the net income would go up.

In other words, there's leeway here. I simply put this forward as a factual set of data. Our work has been replicated a couple of other places and it pretty well stands up as a factual thing.

In fact, EPA has done a survey of nitrate levels in different parts of the country and what they discovered was that in rivers draining forested areas, the nitrate levels were considerably lower than rivers draining agricultural areas. It concluded, for example, that the figures for forest areas were about .9 milligrams per liter of nitrogen, whereas for agricultural areas it was 4.2 milligrams, which indicates pretty generally - and this is all the conclusion that I wanted to come to - that this environmental problem, high nitrite levels in surface waters in the Midwest, is a consequence of a particular kind of productive technology carried out by Midwestern agriculture. Namely, the heavy use of nitrogen fertilizer.

It is not sloppiness, it isn't that somebody by night dumped nitrite into the water, it isn't an act of God. It is simply the natural consequence of the modern technology for growing crops in the Midwest. It's attached to the process of making money on the farm.

We'll have to consider how we're going to deal with that. I wanted to mention that partly for nostalgic reasons, but also because it is a problem which has not been solved. As you know, there's been a lot of talk about controlling point sources of water pollution, things that factories are dumping into the water and so on.

The nitrate leaching into the water from agricultural acreage comes in on every inch of river bank and you can't put a gauge on it to control it. In fact no controls have been proposed. The study we did for the state was intended to provide the basis for a possible state regulation on the rate of application of fertilizer which would have been a historic first. Hearings were held and the farmers objected, and as far as I know no regulations were ever imposed.

As I heard from Dr. Changnon, the problem persists, so here is a problem that we understand. It hasn't been handled and it hasn't been handled because of its close relation to the economy of the farm.

There are a whole series of similar problems that have arisen in connection with water supplies that indicate that pollution problems are not accidental things. They're not sloppiness, they're not the fact that there is waste. They're fundamentally connected to the development of new technologies such as the heavy use of fertilizers and most of them since World War II.

Another good example is the problem of carcinogens in water supplies, for example, down near the mouth of the Mississippi. New Orleans takes a good deal of its drinking water from that river and it has been noted over recent years that substances which are known to be carcinogenic, including chloroform, appear in the drinking water. Why? Well, because the Mississippi drains not only agricultural areas, it drains urban and industrial areas. There are chemical plants all along the Mississippi and the Ohio and the Illinois and the Missouri and they dump various substances, in some cases intentionally. For example, herbicides and pesticides are sprayed on the land and down at New Orleans you can sample in the water supply every one of the pesticides used by agriculture up in the Midwest.

Some of these are hazardous. One of the most ironic things is that the accumulation of these organic compounds in water has interfered with the traditional method of bacterial treatment of water supplies, chlorination. Chlorine is an interesting compound. The only reason it kills bacteria is that it's very reactive. It combines with organic compounds, and one of the things that's been discovered is that when treated with chlorine various organic compounds in water supplies are chlorinated. And the chlorinated compounds are often much more toxic than the unchlorinated ones.

Now, for example, the most toxic synthetic organic compound we know, dioxin - the thing that was in Agent Orange and was involved in the accident in Sturgeon, Missouri, which resulted in a huge financial settlement - is a chlorinated organic compound, and chlorination tends to make compounds more toxic. So we've got this ironic situation that this kind of pollution has now made chlorination not a good way to kill bacteria in water. As you probably know, there have been a number of experiments trying to find some alternative, ozone for example, as a way of treating bacteria in water.

The reason I mention these compounds is, again, they come directly out of a new productive technology that is the development of the petrochemical industry. Just as before World War II no synthetic pesticides were used on the land in Illinois, so also practically no nitrogen fertilizer was used.

Before World War II there were none of these plastic objects that you're sitting on and that I have right here, and so on. Those are synthetic organic compounds produced by the petrochemical industry, which is an industry that was born during World War II and expanded enormously after.

Let me just give you a couple of numbers. Take synthetic pesticide production. It increased from 230 million pounds in 1950 to 1,300 million pounds in 1973. Synthetic herbicides have increased production about 50-fold since 1950. In other words, all of these things are new. You know the plastic olive stabbers that you'll get in your cocktail later on? They're new. In the old days they used to use wooden toothpicks.

Synthetic fabrics - orlon, nylon, dacron - these are all new. They're all made by a new chemical industry which is responsible for the appearance of these synthetic organic compounds in water. And the same story is true about a whole series of other environmental insults.

The reason why we have photochemical smog is that after World War II the auto industry decided to build bigger cars, and to drive the big cars, they had to have heavier engines which operated at a high compression ratio. They also ran hot. Because they ran hot, the nitrogen and oxygen in the air in the cylinder combined to form nitrogen oxide. When that came out the exhaust and it was exposed to sunlight, it became very reactive, combining with the waste gasoline in the area forming smog. In other words, it was the invention of the gas guzzler, the high compression engine, after World War II that gave us photochemical smog.

Incidentally, it also gave us lead pollution, because to run an engine at high compression you have to have high octane values and that was achieved by putting lead into the gasoline.

So again, what I'm saying is we're dealing here not with sloppiness or an act of God, but with the consequence of a particular productive technology, whether it's growing corn or producing plastic olive stabbers and pesticides or building big cars. The environmental problems that we face arise from these technological decisions.

Before I finally turn to the question of relation to the economy, let me take up another problem which is new. That is acid rain. Let me just remind you about the situation.

Rain and snow contain various substances and some of them contribute to the acidity of the rain and snow. Generally, in the natural situation, the pH of rain and snow is about 5.6. If it becomes more acid you run into serious ecological problems. Acid rain leaches nutrients and minerals out of the soil. It also leaches nutrients from the leaves themselves. It enhances microbial infections. It inhibits the establishment of tree seedlings. It cuts the growth of plankton in lakes and in severe cases it kills off fish life.

In other words, acidity in rain and snow is not such a good thing. Most fish species die between pH 4.5 and 5.0.

Let me give you some very simple facts. In 1955 to '56, a survey of the average pH of the annual precipitation that was at 4.5 or less showed that it

covered an area encompassing most of Vermont, New Hampshire, New York, Pennsylvania and West Virginia and parts of Massachusetts and Connecticut. That was in 1955 to '56.

If you drew the bar pH 4.5, essentially it covered a New England area.

In 1972 if you drew that area, the average annual pH was 4.5 or less. It included all the states that I've just mentioned but now instead of covering parts of Massachusetts and Connecticut, it involved all of those states and also the states of New Jersey, Delaware, Maryland, Virginia, North Carolina, Tennessee, Kentucky, Ohio and Indiana and most of Illinois as well as parts of South Carolina, Georgia, Alabama, Mississippi and Maine.

You can visualize that what happened between 1955 and '72 is that acid rain spread from the New England area and it is now essentially over the entire eastern third of the country.

These are facts, and in fact I checked this in Mr. Reagan's report, if I might call it that. Sure enough, there was a map that showed all of Illinois and everything to the east of Illinois covered by that low pH.

All the available evidence indicates that the reason for the low pH is the presence of oxides of sulfur and oxides of nitrogen in the rain.

Where do they come from? We know that power plants and industries burn sulfur-containing fuel. That becomes oxidized and the result is that the stacks emit sulfur dioxide which then can be converted to acidic material in the rain.

We also know that such furnaces emit nitrogen oxides and I've already told you that high-compression car engines emit nitrogen oxides. So, we have basically three sources, man-made sources, for the acidic material that appears in the rain: power plants, some industries that have furnaces for other purposes, and cars and trucks.

The question you have to ask is, Why did this problem appear first in rather the northern regions of New England and, I should say also, in Canada? As you know, the Canadians are very concerned over the problem. It turns out that there is a pattern of movement of the weather which generally sweeps across the north central states. It turns out that you should expect sulfur dioxide and nitrogen oxide produced along the shores of the lakes by power plants and steel industry and so on. Cars being driven in Washington and New York will produce nitrogen oxide that will get pulled up to northern New England.

The acid rain simply began to appear there and it is spreading because emissions of sulfate and nitrogen oxide have risen in recent years. One reason is that EPA regulations are based on the concentration of these things on the ground and one way a power plant can get around it is by simply building a very tall stack. Since EPA regulations came into play, stacks suddenly got very tall.

That keeps the pollutant away from where the plant is, but as you know, everything has to go somewhere and so it ends up in New England and Canada.

There is a good deal of concern because lakes are dying. Surveys have been taken of lakes in the Adirondacks, and lakes that had fish in them a few years ago don't have fish anymore. What's more, it's beginning to affect the growth of trees; pine trees in particular seem to be affected by the increased acidity of the soil.

I mention this because the treatment of this problem is indicative of the regulatory problem that we have. Again, these two recent CEQ reports are a very good way to deal with it. Let me just read you a couple of lines from the two reports about acid rain. One is the pre-Reagan report and the other is the post-Reagan report.

The pre-Reagan report starts the section on acid rain as follows: "The last annual report identified acid rain as one of the two most serious global environmental problems associated with the combustion of fossil fuels. Carbon dioxide buildup is the other. Unfortunately, acid rain may be very difficult to control." So you start off with a very serious thing.

Here's the post-Reagan report. It says: "Although evidence suggests that rainfall has always been slightly acidic in the absence of alkaline dust, over the last three years increased attention has been focused in this country and abroad on the issue of 'acid rain'."

Later on it says, "Because not enough is known about the causes, transport and deposition of acid precipitation, it is difficult to define what, if any, new controls might be needed."

The report goes on and on and, as you know, it is the official policy of the Reagan Administration that acid rain is a problem which is not yet ready to be controlled. Carter had made an agreement with the Canadians to do something about it and they're really quite concerned.

Just to show you I'm unbiased, I'll give you the Wall Street Journal's approach on acid rain. It's kind of interesting; it's an editorial called "Gitche Gumee's pH" and it says, "When Longfellow's Hiawatha was reflecting beside the shores of Big-Sea-Water, it's just as well he didn't know the pH level of those big sea waters." They go on to say in their most scientific way that actually the pH of rain is a natural phenomenon.

There are a few technical mistakes in this. I'll give you one. It says, "Precipitation formed when surface waters evaporate reflects the natural alkalinity or acidity of the soil." I always thought that when water evaporates, what you get is distilled water, you don't take the acidity with it. So it's a little bit wrong, but at any rate the whole purpose of this thing is to tell us that all this should give pause to anyone who wants to commit \$300 billion in hard-earned economic resources to try to alter these natural resources.

Hiawatha might have understood that better than some people today. Again, to be a little unbiased about it, I want to quote from Mr. Stockman - but I'll do that later.

I wanted to present you with these sets of data so that we could confront the question now, What's wrong with the regulatory processes that are now

underway and how could we change them as admonished by Mr. Reagan to make them more compatible with the necessity of improving the economy as well as the environment?

There are two main approaches to controls of environmental problems of this sort. The pre-Reagan technique was established by a series of very comprehensive laws, the National Environmental Policy Act, the acts on air and water pollution, and they give rise to a technique for controlling the environmental problem which runs something like this. The first thing you have to do is to conduct research to evaluate the levels of the pollutant in the environment and to determine the probable effect on health and on ecological processes. You have to make analyses, do research and so on.

On the basis of these data you try to establish standards. You set standards for the various environmental pollutants and then you call for the installation of control devices to reduce the emissions so that the environmental levels come below the standards that have been set.

The last case, of course, is - let's say - carbon monoxide levels from the automobile exhaust. In many cities they were above the standards that were established and the standards were established because a good deal is known about the toxicity of carbon monoxide. It prevents the transportation of oxygen in the blood and people can get sick and die from carbon monoxide.

Certain levels were set when it was found that city air levels were too high. The automobile industry was told to put devices on the exhausts of the car that catalytically converted carbon monoxide to carbon dioxide, and the carbon monoxide levels have come down.

The technique is to regulate by accepting that there are cars that produce carbon monoxide and petrochemical plants that put out toxic materials. You said, "Okay, we're setting standards and now you've got to do something at your plant or on the car to see to it that these standards are met."

In other words, a kind of technological fix. That's the approach. This generally accepts the technology itself, that we're going to have cars that are run on high-compression engines, that we're going to have cornfields that are fertilized. You'll notice now that I haven't given you an example of how the cornfield nitrite problem is controlled because you can't put a gadget on an acre of corn; we'll have to worry about that in a moment.

On the other hand, there are precipitators on smoke stacks, catalytic converters on the car that you're driving, I hope, and that takes care of it. But look at the consequences. It means that you've got to set up new analytical laboratories, epidemiological studies, big environmental studies of the nature of air and water and soil. Then you have to get lawyers together to write the standards and then to defend them in hearings and in lawsuits. The result is you get a big bureaucracy. I still remember the first time I and people like myself had something to do with these new laws, and I remember the first time I saw the EPA Building on M Street in Washington and I said, "My God, what have we done?" We have created this huge new bureaucracy, there's no question about it.

What the bureaucracy is doing is trying to find ways of pushing the genie of pollution back into the bottle now that it's been produced. That is exactly the target of Mr. Reagan's alternative approach. This regulatory approach is where we figure out how we want to control the emission of pollutants into the environment and then set regulations on top of the system that's producing these pollutants. It inevitably results in a big expensive bureaucracy and you know about all of the testimony that businessmen have had in Congress, big stacks of papers, all the forms they have to fill out and so on.

The alternative approach is one which is very clearly mandated by the Reagan Administration, and I can describe it best by quoting from Mr. David Stockman, "I came to the conclusion that the Clean Air Act, like the total model of the solar system that began to develop more and more elaborations and exceptions and complications as the basic model proved to be wrong, has become increasingly unplugged from reality and that we are probably at a point today where the whole thing has gone off the deep end in terms of sheer bureaucratic figures."

It's just made a big bureaucracy and that's all there is to it. The alternative to the regulatory approach has been laid out by Mr. Stockman and here's the way he'd put it - he is talking about acid rain, "I kept reading these studies that there are 170 lakes dead in New York, that they no longer carry any fish or aquatic life. And it occurred to me to ask the question, 'Well, how much are the fish worth in these 170 lakes that account for 4 percent of the lake area of New York? And does it make sense to spend billions of dollars controlling emissions from sources in Ohio and elsewhere if you're talking about a very marginal volume of dollar value either in recreational terms or in commercial terms?'"

I don't think there's any question, and I'm a fisherman, that if you figured out the worth of fishing for trout in the Adirondacks and compared it with the cost of putting stack devices on the power plants in the Midwest to prevent acid rain from getting up to New England, that there would be no comparison whatsoever. That is Stockman's point, and this is the basic point, that you use the free market approach. It's a cost-benefit approach. You ask, "What's the good of those fish up in the lakes?" and there are various ways of computing it.

One common way is to ask what do fishermen spend to go fishing in the Adirondacks, the gasoline, the motel costs, all the lures that they lose in the river and so on. You add all that up and that's the economic value, recreational value, of that ecological resource.

Then you compare it with the cost of putting the device on the smoke stack. That's letting the free market, which you remember Reagan referred to, decide what environmental measures are worth taking. You do it usually by setting a dollar price on the benefits to be derived from the control measures. The current approach in the Reagan Administration is the cost-benefit free market approach.

There are a couple of things you have to realize. One is who gets the cost and who gets the benefits? And you have to remember that some people in

Canada are being hurt by power plants in the United States not carrying the expense of putting control devices on their stacks. Another problem is the impossibility of turning these values into dollar figures. There's now a whole procedure of figuring these things out.

Let me give you one example. It was a paper by Dailer and Rosen that proposes how you calculate the dollar value of protecting your life from a risk and the way they did it is this. They noticed that workers in high-risk industries get paid more than workers in industries that have average risk. The difference for the high risk versus the average ones was about \$176 a year, so they concluded that for \$176 a year a person is willing to take a high risk in industry.

It turns out they calculate whether you should spend money on a seat belt in your car because the risk is there that you'll get hurt in an accident. We have statistics on the probability of the accident and it turns out that, based on this \$176 a year, it's worth spending \$89.80 a year on a seat belt, figuring the probability of being hurt. The authors point out that generally a hundred dollar seat belt in a car that lasts five years means that you're spending \$20 a year. So most of us are being totally uneconomic in wearing seat belts. The only thing is it might save your life.

There are some problems here in trying to translate these things. Let me give you an extreme example, but an interesting one, of this cost benefit, where it leads you.

A few years ago the then-director of EPA, Dr. Eulah Bingham, banned the production of the pesticide PCP when it was discovered that it causes sterility among the workers who produced it. (Incidentally, the EPA is now considering putting it back on the market.) Shortly after she banned the production she got a letter from the Secretary of the Peach Growers Association which used this pesticide. He wrote to Dr. Bingham as follows - you understand the problem was this, that the workers manufacturing it were definitely becoming sterile and the peach growers wanted this stuff nevertheless because they could produce better and more peaches that way - so the peach growers wrote as follows:

"While involuntary sterility caused by a manufactured chemical may be bad, it is not necessarily so. After all, there are many people now paying to have themselves sterilized to assure they will no longer be able to become parents. If possible sterility is the main problem, couldn't workers who were old enough that they no longer wanted to have children accept such positions voluntarily or could workers be advised of the situation and some might volunteer for such work posts as an alternative to planned surgery for a vasectomy or tubal ligation or as a means of getting around religious bans on birth control?"

Now, you noticed that's the cost benefit. I mean, if its going to cost you so many hundreds of dollars to get a vasectomy, well, we'll trade you. You know, "Come work in the chemical plant and you'll save the money." That's the way this cost-benefit thing goes.

The justification for this free market approach is that the welfare of the American people depends on the strength of the nation's economy and that this requires the efficient use of our resources. That's what Mr. Reagan said. The argument is that it is economically inefficient to spend very large amounts of money to accomplish a small economically insignificant improvement in environmental quality.

In sum, this position is based on the notion that such a free market evaluation of the validity of an environmental regulation is essential to sustain the growth of the economy and nowadays, of course, to restore the growth of the economy.

The last thing I want to say is that I am convinced that the opposite is true, that the free market approach is a way not only to damage the environment but also to damage the economy. That's my position. I just want to give you an example of why I've come to that conclusion.

Take this seemingly intractable problem of the nitrate levels. Nothing has been done about the problem. The State of Illinois very remarkably attempted, even held hearings on, regulating the application of fertilizer. Now what did that mean? That means that the state was going to intrude on the technological decisions now made by farmers.

Farmers decide how much fertilizer to put on and they decide according to certain economic considerations. How it will affect the yield of corn, the price of fertilizer, etc. What would happen if that state law with state regulation which never came into being went into effect? It would be that the State of Illinois, society, would intervene in the design of the productive technology which at this point is the exclusive right of the agricultural entrepreneur to determine.

This simply isn't politically acceptable. Farmers don't want to be told what to grow and how to grow it. It's their money, they want to invest it. And that issue, the governance of these designs, is avoided by both the regulatory approach and the free market approach.

I want to make that very clear. No one told the auto industry to redesign the cars. They simply told them put a gadget on the end. No one has asked the farmers to redesign agricultural technology in order to cut down on the use of fertilizer.

If we can overcome this taboo, there are very big economic gains that are possible. I just want to give you one example. Recently the center which I direct has studied for the Department of Energy the production of ethyl alcohol in the Midwest. In fact, we based it on a mathematical model of a typical Illinois farm.

As you may know, you can convert corn to alcohol by fermenting it, but then 40 percent of the nutritive value of the corn is lost. So it looks as though you are diverting food, which is very important, from the market in order to make alcohol. It is said over and over again that any attempt to make any appreciable amount of alcohol would make food less available and the price of food would go up.

We approached this problem in the following way. We asked ourselves, "What is the chemistry of feeding animals as compared with the chemistry of putting fuel in an engine?" If you think about it, you know that to feed animals (and incidentally that's what most of the agricultural output of the United States does - it feeds animals, 90 percent of it, certainly all of the stuff grown in Illinois) there are two biochemical requirements. One is you have to have protein in order to sustain growth and repair functions in the animal and carbohydrate generally is the source of the energy. In other words, when any animal grows, you have to build the machine and then you need energy, fuel, to run the machine. Protein and carbohydrates are essential nutritive factors. Generally, to raise an animal you need, by weight, six times as much carbohydrate as protein. In fact, if you look at the composition of the crop grown in this part of the country and all over the country, it's about that balanced. Why not produce feed that the nutritionists tell you is just right to raise animals?

That's on the one side. Now you look at the engine and you discover that you do not grow the engine and you don't repair it. The engine you get ready-made and all the engine wants is energy to run it and the energy can come from the carbohydrate. It doesn't need protein at all and, indeed, when you make alcohol out of corn what you do is convert some of the carbohydrate into alcohol leaving all the protein behind. Besides it's more protein because you've got yeast growing.

The question then rises if our present agricultural system is so designed as to raise animals and has the appropriate balance between protein and carbohydrate. If we want to produce alcohol as well, we had better change the balance. In fact, that's exactly what we did. We set up very elaborate mathematical models of a typical Illinois farm and simply gave the farmer, the mathematical farmer, the option of changing the biochemical composition of what he grew and how to do that.

It's an old story. As a matter of fact, after World War II is when everything happened. Before World War II, there were no soybeans in Illinois and the protein-to-carbohydrate ratio of what was grown here was off balance. There was more carbohydrate than protein because it was corn. Soybeans have a lot of protein and the whole introduction of soybeans jacked up the protein level and balanced it out.

What I can do instead is to replace soybeans with sugar beets, which have a lot of carbohydrates. What we discovered was that a typical Illinois farm raising beef, for example, by shifting over to sugar beets could produce exactly the same amount of protein as a conventional farm raising corn and soybeans and 50 percent more carbohydrate. That 50 percent more carbohydrate fermented off to make alcohol produces enough alcohol that by 1995, we projected, the farmer's income would double simply by shifting over in that way. In fact we discovered that this kind of shift all over the Midwest would produce enough ethyl alcohol to replace 20 percent of the gasoline used in the United States with no reduction in nutrients or livestock. And it would raise the farmers' net income profit by \$20 billion. That's a lot.

Now you say, "Well, what's going on here? You mean to say the farmers could be a lot richer than they are?" Yeah, and you know what they're doing, they are recapturing part of the transportation market that they lost when the horse was replaced by the car. You remember, farmers used to not only feed the vehicles of transportation, they grew them. When the oil industry and the auto industry came in, farmers were displaced from that sector of the economy and were pushed back to being only producers of food.

Now, as you know, getting into the energy market is very lucrative. In fact, the farmers would be making windfall profits because the price of alcohol would be pegged to the price of gasoline which I guarantee you is going to keep going up. In other words, what this takes is a reorganization of the system of production. This could be done with much less use of fertilizer from the other results that I mentioned, and if we avoid the taboo that we must then change the pattern of production, we could literally satisfy the entire agricultural sector of the country, cutting into the gravy that the oil industry is getting. Building up its own economy, would this be good for the country? Yes.

Because alcohol is solar energy, it is totally renewable. It would begin to make us independent of imported oil. Incidentally, there are techniques beyond that of using agriculture. If we use cellulose from scrap wood, from old newspapers, we can replace all of the gasoline and diesel fuel that we use because there's a way of breaking cellulose down to sugar and then fermenting it.

The only reason why I go through this is to point out that the critical question is the design of the productive technology and our willingness to change it for the sake of improving the environment. If we changed agricultural technology, nitrate levels would come down. If we went back to low-compression engines, we could get rid of photochemical smog. If we went back to cotton shirts instead of synthetic ones, a lot of pollution would disappear. If we managed to get along with wooden olive stabbers instead of plastic ones or even decided that it wasn't necessary to have a pack of beer cans strangled by a piece of plastic and everything that you buy in the store covered with polyethylene - you know, in the old days you bought things and they weren't covered with plastic and I well remember drinking beer out of a bottle. In fact, I still do.

In other words, these transformations have taken place under the driving force of the free market. Because, to make matters very simple, every one of the changes which I have described has come about because it's improved the profit of the corporations who are involved. As Henry Ford said, "Many cars make many profits." It's more profitable to produce plastics than it is the objects that they've replaced.

The point I'm making is that the real issue that we're confronting, which is an issue that will affect both the environment and the economy, is whether we are willing at last to govern the design of our system of agricultural and industrial production not by relying on short-term profits that a particular manufacturer or a farmer may be interested in but by asking what design of production is good for the country, both environmentally and economically.

That's a problem that isn't going to get solved very easily because this involves very deep social and political questions. Nevertheless, I think this is the only way in which we're going to be able to meet Mr. Reagan's admonition that we should improve the environment and the economy at the same time.

I think we have to be thankful to Mr. Reagan for raising what is basically a politically revolutionary question. Thank you.

Questions Addressed to Mr. Commoner

MR. BEAVER: Do you think the farmers will accept the use of less nitrogen if it was a national law instead of a state law?

MR. COMMONER: I think that a national program is what the farmers need. My impression is that farmers are devoted to the task that's been assigned to them, producing food, and they do want to do it in a sensible way.

If, for example, the federal government were to say, "For the following reasons, we think that it would be important for agricultural lands to support not only our production of food but the production of alcohol fuel, and we will take steps to provide the farmers with the information, the new seeds, the demonstration plots, the distilleries that will accept the grain and sugar beets that are being produced," I think the farmers would respond.

I'll put it very practically to you. At the time we bought into Chrysler - you know, we all own parts of Chrysler - at that time, if the government had said, "Since we now own part of Chrysler we want Chrysler to produce simple stills that farmers or farmers' cooperatives could use to make alcohol," I think we would have a very rapidly growing alcohol program. I think the farmers would respond.

Actually, even in the absence of this, all over the country farmers have experimented putting together their own stills, setting up cooperatives. Incidentally, the production of alcohol for gasohol has been going up very rapidly, only quietly, because they decided not to use the name gasohol. It's now called ethanol unleaded gas because, you understand, what the alcohol can do is replace the octane booster. It's a long story. Actually it's been known since 1922 that alcohol is a very good octane booster and when they took the lead out of gasoline it would have been very simple to say, "Okay, let's use alcohol instead."

What the oil companies did was to find some oil product that they could use. In other words, what I'm saying is if we had a policy and gave the farmers the information they needed, I think they'd go along with it.

AUDIENCE PARTICIPANT: Can you filter nitrogen out of water and what type of --

MR. COMMONER: Can you get the nitrate out of the water?

AUDIENCE PARTICIPANT: And what type of cancer does nitrite cause?

MR. COMMONER: To get nitrate out of water is extremely difficult because it's very soluble and it's simply -- I guess what you've got to do is something like distillation. It's about the only way you can get nitrate out. There's no way of precipitating it. Every nitrate salt is insoluble. Nitrite from nitrate combining with amino acids forms nitrosamines. These cause, typically in animals, liver cancer. There's been a good deal of research about that because it may turn up in smoked meats and so on.

AUDIENCE PARTICIPANT: I have two questions for you, Dr. Commoner. First of all, is it technically and economically feasible to produce nitrogen fertilizer which could either be encapsulated as a way of reducing nitrite levels? And secondly, our larger utility in the state has had advertising campaigns which have tended to confuse the public to some degree on the acid rain issue, primarily by their ads saying that studies have shown that some lakes in the northeastern part of the United States within 20 or 30 miles of an acid lake have normal pH levels. I was wondering if you would comment on that and if you're aware of those studies.

MR. COMMONER: Yes, there are encapsulated nitrogen fertilizers. I don't think that manages to do the job because it's not so much the rate per day at which the nitrate gets in, it's the relationship between the amount put on the soil and the amount that the plant takes up. It does help to put the nitrogen on at the right time of year. You can make the situation a lot worse by allowing nitrogen to be on frozen fields, for example, or in general putting nitrogen on the soil during the period when the plants aren't growing rapidly. But the big problem is that we simply are giving the soil more nitrogen than the plants possibly can take up. And it's got to go somewhere.

The business of acid rain. I read you those things just to remind you it's a very big controversy now. About the lakes, let me put it to you this way. There is clear-cut evidence that the number of lakes with critically low pH has gone up precipitously in the last 25 to 30 years. I don't know of any natural phenomenon which has changed in that period of time. This sort of study has been done much more in Europe. The Swedish researchers have shown pretty clearly that this is a result of power plants in Europe dumping stuff in Sweden and I think it's pretty clear that this is true here, too.

You understand that the pH is a function of what is dumped in the lake and the natural buffering of the water in the lakes which depends on the nature of the soil. For example, here in the Midwest where there's a lot of limestone which is a good neutralizer of acid, the lakes are much more resistant to acidification than they are in New England where the underlying strata tend to be granite. I can easily see, let's say, a lake which has slightly different strata near another one reacting differently to the same deposition of acid. Enough hasn't been done to figure out why these things are happening, but the fact is that more and more acid is being dumped over the eastern part of the United States and Canada and more and more acid is being produced downwind from those areas. The only logical conclusion you can come to is that there's a relationship between those two things.

The reason why there's so much discussion about it is that nobody wants to deal with it economically. It's going to be an expensive proposition. It means, for example, changing the whole nature of the automobile engine because a lot of nitrate is coming out from the cars.

Incidentally, a little complication. When you look at the growth of trees, you discover that there's a positive effect of the acid rain because it's putting nitrate fertilizer on the soil. In some cases where the acidity is much more due to nitrate than it is to then you may find that the trees aren't much affected because while the rate of growth is being affected by the acidity, it's being increased by fertilization.

In another area where the acidity is mostly sulfide, then the tree growth will be cut back and of course, you know, these are all complications. The trouble is that like the editorial in the Wall Street Journal, this is being used to say, "Well, we don't understand it so let's not do anything about it."

The real reason we're not doing anything about it is it's going to cost the power company a lot of money.

AUDIENCE PARTICIPANT: If we are to assume that environmental protection and economic revitalization are dual national objectives, could you elaborate on your vision or view of the appropriate roles of government at both the federal and state levels?

MR. COMMONER: In the first place, the point I should have made is that we should adopt the idea of preventing the environmental assault by regulating the design of the system of production - I'll put it to you very simply. Suppose that during World War II when the big cars were being designed to be put on the market, suppose that we had a policy that we shouldn't have cars that produce nitrogen oxides and guzzle gas, it would have taken a very small government agency to sit down with the auto industry and say, "Hey, you can't do this. Why don't you figure out some other way of designing the cars?"

In other words, we would have prevented smog and by preventing smog we could have wiped out half of EPA. You wouldn't need all the tests and the lawyers and the regulations. I'm convinced that if our regulatory approach were prevented, saying a technological design in industry and agriculture shall consider environmental impact, I think that most of our regulatory bureaucracy would disappear. It would be a lot simpler.

I think that this sort of policy has to be federal but I think the states ought to figure out changes in local production. I think it's silly, for example, to ask Washington to decide just how fields in Illinois should be fertilized. I think that's something that can be worked out best in Illinois. Incidentally, it will vary from county to county and I think that the execution of these things ought to be done by the state.

But the principle that we have to establish is that we're going to use a preventive approach. I think that would cut the regulations way, way down. Most of the regulatory agencies that Reagan squawks about came into being to

put band-aids on the wounds caused by the wrong productive decisions. That's why they're very elaborate.

AUDIENCE PARTICIPANT: In terms of your solution, you pointed out the difficulties when you have an elaborate bureaucracy making decisions. Granted that these are a band-aid decision, I think that perhaps the falsity still exists when you ask for a centralized decision-making body to make decisions about production. It seems to me that you still have the problem and I would suggest that really the lack is in terms of the intelligence of the people as a whole which includes the productive sector as well as the citizens. You have the individual farmers, you have the individual factory owners, but can we trust an isolated group of bureaucrats in Washington or in Springfield to go out and tell thousands of farmers or factory owners how to organize their production? It seems to me that the real implication of your speech is that if this knowledge or this intelligence of how the system works was more prevalent, then naturally farmers and factory owners would start to make the decisions.

And secondly, if the people themselves had this knowledge they would either change their consumptive habits or tell the farmer they wanted it to be done differently.

MR. COMMONER: Well, perhaps I didn't make myself clear. I think all that is required centrally is the social decision that environmental impact will be considered in making the productive decisions. You're absolutely right. You're not going to be able to tell a particular factory just how to produce a car that meets the standards. I think what's needed is a general social decision and let's not duck it. It's going to be politically very difficult. A decision which says that society has the right to participate in the productive decisions of various enterprises. As far as I'm concerned, that's the only central statement that has to be made.

But that is the most difficult thing because that violates the basic precept of, to put it technically, capitalism, what's called free enterprise.

AUDIENCE PARTICIPANT: Just one comment on that. It seems to me that all of us do have the ability to make that decision and unfortunately we all made a bad choice when we bought those gas guzzlers. But a lot of people have decided they won't buy them and so the industry is suffering as a result of not producing them. But the decision starts and ends with the people.

MR. COMMONER: That's a common idea that I don't quite share, that you blame it all on the consumer. The reason why we have big cars is that we wanted them. Now I'll give you an apocryphal reply to that having to do not with cars but with socks.

I wear size 10 1/2 socks. When I go into a store and ask for 10 1/2 socks, they point to a shelf where there is size 10-to-13 and they don't have sized socks. Now I ask you, that's a big change that's taken place in the technology of producing socks, right? Do you know of any consumer who came into a store in the old days and said, "Hey, listen, I don't like these fixed-size socks because my foot changes size every week so I really need a flexible size sock?"

I give you that as an extreme example of a technological change that was not brought about by the consumer. It was brought about because the consumer experts figured out that it lowered the inventory and made more profit.

Now take the car. Yes, people wanted big cars when they knew they could get them. But suppose, and I would argue this, suppose when those big cars went on the market they put a window sticker on them with all the characteristics and they said, "This car is 20 percent bigger than our previous one and it's roomier in the knees and so on and it uses 30 percent more gas and we suspect that it's going to cause a nasty environmental pollution. Now buy it." See, the consumers are not informed. They're not informed about these environmental problems. They get the good side of the story, and I think that's where the trouble lies.

AUDIENCE PARTICIPANT: If the National Policy Act does require consideration of environmental considerations in major policy, the problem is they're not required to do anything about it --

MR. COMMONER: Exactly. There you put your finger on a very interesting thing. I recommend to you that you get ahold of NEPA, of the Act, and read the two sections, 102C and 102D. Section 102C is the famous section that requires the environmental impact statement and that's the whole thing that everybody says, "Well, here's what's gonna happen" and so on. The law does not require the government to do anything else but to make the impact statement and if that is all that happened, nothing would happen. But a very funny thing happened on the way to the court. The judges in many courts have decided that what the impact statement shows should be carried out, and that's why we get various actions.

Now 102D is a fascinating section. It says that not only are you supposed to assess the environmental impact of the productive process that's causing the pollutant, but you are to look for other ways of carrying out the same process that have a lesser environmental impact.

If that were carried out, here's what would happen. Take those chairs right there that you're sitting on. They have plastic upholstery. As far as I understand the act, the head of EPA could hold a hearing which says that the manufacturer of that plastic is causing the appearance of toxic chemicals in waterways, in the air and so on, and we're going to hold a hearing to find out if there is another way of upholstering that chair which has a lesser impact on the environment.

A leather manufacturer could come in and say, "I have it." If he could show that the production of that much leather has a lesser impact on the environment, the EPA administrator would then be in a position to say, "When you make chairs, you're going to cover them with leather instead of plastic." You've now accomplished exactly what I've been talking about, and I'm no legal expert, but my guess is that a rigorous interpretation of Section 102D of NEPA would allow social government the means of production which would turn a lot of people pretty angry. But you're right, it's a very peculiar thing. The government is not required to act. The courts have changed that interpretation and said you've got to do what the impact statement says.

AUDIENCE PARTICIPANT: I believe that the Toxic Substance Control Act does, in effect, accomplish what you're trying to suggest here.

MR. COMMONER: That's right.

AUDIENCE PARTICIPANT: And it requires an evaluation of byproducts and new chemicals introduced on the marketplace.

MR. COMMONER: Yes.

AUDIENCE PARTICIPANT: That probably could be expanded to other arenas. My question would be, For the already-entrenched power groups and the types of technology we're now using, how do you employ this concept? I mean, it seems like a good idea for the prospective problem, but what about the ones that are here today?

MR. COMMONER: Right, the business about the Toxic Chemical Act really is very interesting. It is by far the most politically revolutionary act of the whole series and carries to an extreme what was tucked away in Section 102D of NEPA. How that ever came into being I don't know. It's a very interesting story.

The chemical industry fell asleep at the switch but it is literally true that the kinds of social intervention that I'm talking about can be carried out under TOXCA.

AUDIENCE PARTICIPANT: Well, what about the problems?

MR. COMMONER: How do you go about it? I worry about these political things. My guess is that you have to confront the basic political issue head on. You have to raise the question, Is it time that we begin to think about democratically, socially determining what we produce and how we produce it rather than leaving this to the decisions of the people who own the capital who always do it simply to maximize their profit?

You understand that I have now described one-half of the definition of Socialism. I don't mean to worry you too much but it's a fact. Socialism means social ownership and control of the means of production. I've just described, and TOXCA includes, social governance of the means of production, not necessarily ownership.

I myself happen to think that that's the more important half of the definition of Socialism. I think that we literally have to confront this bugaboo, that we should find ways of democratically, in a decentralized way, without bureaucracy, having the people of the country able to participate in these decisions. That is, I think, the political issue of the next decade.

The trouble is I don't know of a single conventional politician who will even acknowledge that the question exists, much less discuss it, and much, much less take a stand on it.

If it will encourage you at the end of this meeting, I can tell you that probably the most prominent human being on the earth's surface has taken a stand on this which says that society ought to govern the means of production. I am referring to Pope John Paul. Big surprise. He wrote an encyclical about six months ago on human labor in which he made a very simple point about capital. You understand capital is what you invest to do these things and the owners of capital say, "It's my capital, I'll decide what to do with it." He pointed out that capital is created by the work of labor. This encyclical was about work and labor and so forth. He said, therefore he thinks and the Church believes, that it is morally correct that workers should have a governance over how the capital is used.

There you are. The interesting thing is how many of you have heard of that encyclical? How many of you have heard of the Pope's encyclical? [Show of hands] That's a very high percentage. I don't know of a single national politician, including Mr. Kennedy who has a natural affiliation with the Pope, who will even mention this thing, ever. In other words, what the Pope said is that this is a big moral question on which he has taken a stand, yet it isn't even discussed.

My own sense is that we're not going to get at this thing by some clever new act. We're going to get at it by saying, "Look, we have a moral problem here." Do the people of this country have a right to intervene at that point? You're going to get an awful lot of flack from the Wall Street Journal and Mr. Reagan and Mr. Stockman and we'll see how it comes out.

Until we have that big national debate I think it's going to be very hard to solve the environmental problem in the way that you described. We got to the nub of the matter now. Thanks.

THE NATURE OF PROBLEM SOLVING

William W. Frerichs, Manager of Research
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Yesterday all of our speakers noted and agreed that there was a problem, that we do have a problem with water resources, that there are conflicts that do exist and will exist. I think an important step in problem solving is a recognition that there is a problem.

What I am going to attempt to do is go over some of the bureaucratic ways of dealing with problems and hopefully set the perspective for some of our other speakers this morning.

The first thing that people at ENR said when I told them the title of my talk, "The Nature of Problem Solving," was "Good Lord! What a boring title. Highly academic." What it is, though, is a reflection of my set of values, my perspective, on what should be addressed.

Values are something that are important for us to talk about, and I will try to examine them in a little further detail than some of our speakers who talked about and referenced values yesterday. Some of the things that I want to go over are: What do we do with values? and Exactly what are they?

The fact is that everybody has a different way of dealing with problems. There is an adage that I learned when I was working for the Navy a number of years ago. It's something that we had hanging on the wall, and it said, "When in trouble, when in doubt, run in circles, scream and shout." That is one way of dealing with problems. We didn't often use that approach, but it was nice to have it hanging up there; at times it provided a light way of looking at problems.

We have been talking in this conference about temporal, spatial, quality and quantity relationships of competition for water. There are analogies or parallel ways of looking at problem solving that relate to those factors.

When we talk about temporal factors in problem solving, we have to look at when something is going to be solved and what are its future effects. When we look at spatial components, we have to look at which areas are going to be affected. When we look at quantity, we have to look at how many people we are talking about, people who are going to be satisfied with an ultimate solution.

When we look at quality, we are looking at how good the solution is, how acceptable it is going to be, how people feel about it, how their values are reflected in the solution. All of these factors have to be kept in mind when we are trying to solve any problem, but they especially apply to water resource problems which tend to be highly complicated, where many factors have to be taken into consideration.

With those basic considerations out of the way, I would like to look at how water resource policies and decisions are ordinarily made. A lot of people don't look at that very often. A number of years ago, Dave Braybrook and Charles Lyndblom found that the strategy employed by most decision makers for evaluation and analysis tends to be incremental, restricted (that is, not many options are actually looked at), means-oriented, restrictive, serial, remedial and fragmented. "Exactly!" you say? Right. That is how decisions are made. All of these things. "Fragmented" and "incremental" are particularly applicable.

In terms of water resource problems, we can take a look at a couple of quick examples of why water resources have utilized this fragmented and incremental approach to decision making.

An example: Some people want a dam built for flood control, or for recreation. There are a number of different values and aspects which are examined. State and federal legislatures are lobbied, hearings are held, legislation is passed, plans are drawn, impact statements are developed, a number of different permits by different agencies are issued. Monitoring is sometimes done, sometimes not done. Alternative uses are determined and changed as time goes on. In other words, an incremental and fragmented approach in dealing with the water resources issue is used.

But why does it have to be this way? Well, Braybrook and Lyndblom have answers for that also. They say that humans have limited intellectual capacity. That means we can't think about too many things at one time, which is true. We have limited knowledge; and we don't know everything about everything - or all of the issues in a particular situation.

Analysis can be expensive; that is why the Army Corps tries to get out of doing some of the analyses. It's lengthy. It's time consuming. People are involved, resources are committed. If you can make a simpler or quicker decision, it's less costly. Who really knows how things work? Is there anyone who really knows how some of the relationships, particularly in water resources, interact with one another?

Another consideration is that facts - hard facts - and values - people's values - are often intermixed. I heard a discussion once in which someone stated that "it would be nice if a lie detector was built into a podium so that when a speaker was at the podium, you could tell whether the speaker was lying or telling the truth." I think that is a nice thing to examine in theory, but not very practical because of people's values. They may get the facts mixed up, and they may indeed feel that they are telling the truth even when they are not. It is important to keep in perspective that people's values often distort the facts.

Braybrook and Lyndblom go further to argue that the incremental approach to problem solving has safeguards built into it that actually lead to the best solutions. Well, what a relief; bureaucracy is defensible. We can say it's okay if we have to do a fragmental-incremental approach because it has safeguards. If we have to go through five or six different agencies, we're at least assured, for the most part, of getting five or six different viewpoints, getting five or six different ways of looking at the problem, to uncover facts that other people in other agencies may not uncover.

When we deal with complex water resource issues, then, can we take an incremental, fragmented approach? Can we afford it? I would suggest that, yes, the fragmented, incremental approach is the way to go with certain limitations.

Let's take a look at what is going on today. Scientific research is uncovering more and more interdependencies between disciplines, reactions and system interdependencies in general. The public has a growing expectation that it is going to play a part in making decisions. It's a value change. These changes have to be taken into account when solving water resource problems. That we incorporate science and let the public be involved does not necessarily seem to fit into a fragmented, incremental approach, but I think it does fit.

The definition of an ideal - optimal - solution, which is a term that planners or bureaucrats want to use many times, should be that of a solution which respects all values (how all people feel on different things), maximizes returns to everybody and protects future values (those values which aren't expressed today, but which indeed may hold true a generation or two from now). We may as well call it the definition of the impossible. There is no way that we can meet that optimal solution.

When we talk about optimal solutions, we should define what we are looking for. What are we really talking about? Are we looking for the best return for the dollar today or looking for the protection of a particular water resource to the maximum extent possible? We have to define what we are trying to solve, what the goal is, and make that very explicit.

Another way of looking at it, a way in which we sometimes tend to look at it in bureaucracies, is that if we make a decision and everybody is mad at us, then we must have made a right decision. There is perhaps a little bit better compromise position. It's not too much different: if we take a position and everybody is marginally pleased - marginally, not altogether, pleased - then we have probably made a fairly good decision. Whether or not any group or individual is marginally pleased depends on what values they hold.

Values have to be examined in a decision-making process, and they are through different decision-making processes such as public participation. Although some people don't hold that public participation is true public involvement, it is one way of getting a handle on what people's values are.

Conflict in which there are two opposing sides offers a nice simple situation - simple because in most water resource issues we have more than two opposing sides. Sometimes we have five or six or a dozen opposing sides. If we come up with the optimal, best, solution that is possible, the two sets of values of each of the opposing groups would overlap at some point and the solution would be up in the middle where the overlap occurs.

If we have two opposing groups whose values are so far apart that we either have to go in between their sets of values, miss their sets of values, or go within one group's or the other's, we are not going to resolve a conflict. There will continue to be a conflict because there was no marginal satisfaction. There will be a decision, however.

What about future values, how do we know that a solution will protect future alternatives? One of the ways we can do it, a built-in safeguard, is by allowing for and examining alternative futures - what we think the future may look like under a series of different situations - allowing management flexibility in our decision making today and pinpointing times in the future when we have to reexamine our decisions. At what point in the future, if we don't do anything differently, will we restrict our options to go back and recover?

The Florida case that was gone over yesterday is an example. There is serious talk now about changing the canal back to somewhat of the natural configuration it had before it was altered. Ordinarily, 10 years ago, we would have thought that once the canal was built, we foreclosed our option of ever doing anything with it again. That is not necessarily the case today.

In the Florida example, we may foreclose the option if we don't act within the next five years for health of the lake. That is something that has to be examined in detail. The reason we use an incremental, fragmented approach is because we don't know enough, because of humans' limited capacity, as I said before.

People say, "What about computers?" Computers can really extend humans' intellectual capacity. They allow us to overcome our natural shortcomings. Certainly, to an extent, that is the way we are headed. We are making more and more use of computers. We are using forecasts, models, simulations, manipulation of vast data sets. These are ways of dealing with complexity that humans alone, thinking, sitting around a table, cannot necessarily deal with, but it does not necessarily lead to the best decision for society.

It allows us to make better use of some of the information we have. There are still human impacts and human interpretations. If a computer could be hooked up with a crystal ball and we could model alternative futures, we'd know what is going to happen in the future. Too bad we don't have that. It is difficult to know exactly what will happen from any action that we might take. Let's also keep in mind that science tends to be revolutionary in nature; a transition from one paradigm or accepted term to another occurs in a relatively short period of time.

So, what we accept as a given today may change tomorrow. What do we do then when we run the models and find out later that we were really using the wrong paradigm? We say, "Oops, so sorry, we have to go back and do it again." We always have to allow for that change; science is revolutionary, and changes will occur. Another aspect of using computers in problem solving is how to explain results to the public? How do we get that understanding across?

If we are using 30, 40, 50 researchers' efforts in developing the models and putting in different information and manipulating the systems, is any one person capable of explaining to the public exactly what was done?

Well, I think not. I think what is really called for is a new breed of bureaucrat. Rather than the regulatory bureaucrats, we need to have the "explainer" bureaucrats, whose whole function is to go out and explain things succinctly, clearly and accurately.

A number of speakers yesterday brought up the need for education. I think there is a need for this intermediary role on the part of the "explainers." We can use parables, analogies, pictures, charts, a number of different means of presenting some of the complex themes. Where does that leave us? Computers are a useful tool in a decision-making process, but they will not enable us to move in the optimal mode of problem solving, to give us the best decision for now and the future that respects all values. There is a lot of human interaction that has to go into the best decisions or solutions to a problem.

Another way of dealing with problem solving today is better coordination between the fragments of bureaucracy with which we have to deal. Coordinated review processes are one way of bringing a unifying force into the decision-making process. You can get better information, more coordinated information, out to the public. Coordinated meetings cut down on the time needed to make decisions and perhaps even cut down on the cost of permitting processes without putting environmental safeguards in jeopardy.

There is a coordination role for someone who can explain, "Yes, you are going to have to get a dozen permits. Here is the time schedule, and here is what we are doing." We are trying that in Illinois. We don't have any project in the process right now but we are willing to see how it works. We think it's a very useful approach.

Coordination in general is a major step that can lead to more understandable solutions. Often the myriad of federal and state agencies use different assumptions for the same type of analyses. I am not saying that that is incorrect. Sometimes that leads to a range of solutions at which we wouldn't ordinarily arrive.

With just one set of values - say population, for example - a number of agencies use different population forecasts. One state or federal agency better be able to succinctly and clearly tell the other agencies involved exactly what it has done. Oftentimes that is not what is done at the present. They say, "Well, we use the 'x' population projections," but no one can explain what those are or what assumptions went into them. A little bit of coordination and better communication are necessary.

I offer the following quote to help pull things together at this point. "Often, correct knowledge can be arrived at only after many repetitions of the process leading from matter to consciousness, and then back to matter; that is, leading from practice to knowledge, and then back to practice." It's a quote from Mao Tse-Tung. In a more familiar tone, "If at first you don't succeed try, try again." That is a little more succinct and less bureaucratic.

Economics' role in problem solving has been discussed more and more. A number of speakers yesterday brought that up. Economics relates to the distribution of goods and services. Goods and services, or the demand for them, often reflect values or represent a quantification of abstract values.

You can sometimes use economics to represent the quantification of abstract values, or at least you can try to. If you value something highly, you are willing to pay more for it than for a less valued object.

Cost benefit analyses have been invoked for some time now in the problem-solving area. When I speak of cost benefit analysis, though, I don't want to speak of it in the same way that Barry Commoner brought it up in the peach growers' letter yesterday. I think there is a nonrecognition of values in that letter.

We have to specify, if we do a cost benefit, who benefits - where - and when the benefits are going to be distributed. They are hard things to put your finger on, and of course things, objects, values, can be over- or under-valued. As they have been in many water resource projects.

Cost benefit analysis can be extremely useful in examining alternative approaches to the same end goal, however. One of the most applicable situations for cost benefit analysis is when a specific end point or goal is known and there are a number of alternatives to get there. Cost benefit analysis can be used to come up with different ways, the least costly way, to a particular goal. Some of the undervalued projects or values that have come up in water resources are certainly in the cost benefit analysis of different projects of the Army Corps of Engineers. There have been a number of court cases that have taken the Army Corps back to zero when they found out that either costs or benefits, however they accounted for them, were distorted or didn't really reflect reality.

When we talk about the economic benefits or costs, they are meaningless unless they are clearly defined. Net to whom? Net to where? Net when? You have to set up strict accounting procedures at the beginning of a study, not at the end, whenever you use cost benefit analysis.

A common theme emerging in problem solving is basically truth and understanding. It's a noble theme indeed, but essentially solutions are to be validated by the public and decision makers. If that is to happen, we are going to have to have that understanding. We are going to have to have the truth presented. Weaseling, hiding behind laws, hiding behind engineers and scientists all spell defeat for projects.

What are the factors which drive bureaucrats (public and private) to these nefarious means to obscure the issues? There are several:

1. Politics - Politicians are working in a short time frame. They are elected for two, four, six years. In terms of governmental bureaucrats, there is a desire to be in line with the election process. Legislators are the ones who approve budgets and can affect problems.
2. Fear of the public - bureaucrats are sensitive to criticism. Once burned, twice shy.

Changing from confrontational exchanges to a partner-type relationship should help this problem between groups, but certainly confrontation is always going to be necessary for recalcitrant officials. An essential point is: Why assume right away that confrontation is necessary? It may not be. It's always worth a try to go the other way.

3. Bureaucrats are also afraid because of the fear of the unknown. How much work is necessary? How much is this going to cost me? This has never been done before. Who are these people?

I can personally vouch in terms of working with the public. I have never been attacked, physically anyway, met any ogres or had to work 24 hours a day. The only bad thing I have run across in public contact is bad fried chicken and mashed potatoes that I could have used to patch my concrete sidewalk.

The last item I want to touch on is the question, How much information is necessary to make a decision? Haven't we all heard the phrase, "We don't have sufficient information"? Clearly, this attitude can lead to additional problems. Can we afford to say, "Let's see if people can get cancer from drinking water over a 20-year period of time"? Can we afford to say, "Let's see if we really run out of water"? Can we afford to say, "Let economics dictate the use of water? So what if you can't afford it?" Can we afford to say, "Drought only occurs every 20 years, and we had one last year, so let's not worry about it"?

I think that the answer which everyone in this room would give is a resounding No! No, we can't ignore that we have problems. We don't have to know the exact dimensions of a problem before we start making some decisions.

So, whether we deal with private or public solutions, as proposed yesterday, what we need to do, in essence, is lay out the alternatives, lay out the information, make best use of the information and get a dialogue going. It doesn't matter which alternative, whether you favor the case of Steve Hanke yesterday, fragmentizing all the water resources, or of Barry Commoner going for a more social system. It doesn't matter if you are for direct government intervention. The public should be involved, has to be involved, in trying to make these decisions and seeing where they will lead. It is going to be an essential part of problem solving. We are going to have to have that contact. We are going to have to have that dialogue.

DOING MORE? - THE TNRIS APPROACH

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Good morning. I am going to present a paper that I have entitled a little bit differently than appears on your program. I don't know that the title makes much difference, really. "Doing More? - The TNRIS Approach." You know, in listening to some of the other speakers, I have learned that there is Northern and Southern Illinois. Yesterday I heard about Northern and Southern California, and the distinctions, and even some questions as to whether or not perhaps there ought to be a division in the State of California, if I remember correctly.

We have, of course, serious water problems in the State of Texas, and we entered the United States under a treaty that gives the authority to divide into five states in Texas if we so choose. There has been no serious discussion of that possibility up until now.

The Texas Natural Resources Information System was privileged several months ago to be visited by the representatives of the Illinois State Water Survey, Geological Survey and Natural History Survey. I am honored to be with you at this important conference as a follow-up to that visit.

Staying afloat is, can be, and has been a feat of some difficulty in various parts of the United States. The late H.A. Beckwith, at one time a member of the Texas Board of Water Engineers and then later of the Texas Water Commission, commented on the vagaries of precipitation in Texas thusly, "There's either too much or too none."

From 1950 to 1956 Texas experienced its most severe drought since 1889, when rainfall records generally began to be kept. That drought was broken by rains that produced serious flooding in many areas of the state. That drought also led to the enactment of the Texas Water Planning Act of 1957 and the beginning of modern, systematic, state-level water planning.

There were other results of the devastating drought of the '50s. The 1957 Act mandated a planning inventory, which was published in late 1958. This was followed by a state agency report in mid-1961 outlining a plan for meeting the 1980 water requirements of Texas. Study and planning endeavors were also undertaken singly and jointly by federal entities with some degree of state-level input. Published results of studies, inventories and plans appeared with some frequency.

In 1964, the governor of Texas asked the then-Texas Water Commission to begin at once to develop a comprehensive, longer-range State Water Plan. Extensive effort was devoted to the planning endeavor by the Commission and its staff, assisted by a prestigious advisory panel, numerous consultants, several

universities, federal agencies and river authorities and water districts throughout the state.

Amid the intensive planning activity, the state legislature in 1965 realigned two of the water agencies. In 1967 as the Texas Water Plan was still under development, the state legislature established a water quality management agency.

Experience with the process of developing the water plan clearly identified the need for improved water-data availability. This need was communicated to the state legislature, and in its 1967 revisions to the Texas Water Code, the legislature directed the state's planning and financing agency - the Texas Water Development Board - to establish a centralized data bank incorporating all hydrological data collected by state agencies.

As is often the case when legislation of this type is enacted, no appropriation was made to enable the mandated work to get underway. Consequently, the Texas Water Development Board and several other agencies in Texas state government concerned with water data began voluntarily seeking to address establishment of the data bank. This effort was initiated through a committee dedicated to exploring hydrologic data acquisition, needs and uses by the several agencies. In the beginning, the members of the group met on a strictly informal basis.

By mid-1968 the informal group requested and received recognition from the Planning Agencies Council for Texas (PACT) and was designated as the Water Oriented Data Programs Section (WODPS) of PACT. WODPS by this time was being participated in by eight state agencies which required hydrologic data to be obtained in compliance with permits, collected or funded the collection of such data, used a particular type of water data regularly or periodically, and/or needed additional water data of various types for a present or future use.

WODPS began to work toward establishment of the Texas Water Oriented Data Bank (TWODB). Among its first efforts was the development, in concert with work that was being done at that time by the U.S. Geological Survey's Office of Water Data Coordination, of a catalog detailing all non-federally collected data which resided in the files of its member agencies. The catalog was organized along hydrologic lines. A separate catalog volume was produced for every delineated river and coastal basin in the state. Bay and estuarine data which would not logically fit the basin catalogs, but which might need to be aggregated as a whole, were accommodated in an additional volume covering the bays and estuaries of Texas. In all, 24 volumes were compiled over a three-year period beginning in July 1970.

The cataloging endeavor was undertaken with staff capability voluntarily provided by participating state agencies, assisted by the planning staff of the Governor's Office. A modest level of staff support to the overall effort was provided by the Texas Water Development Board.

A number of frequently used water data files were computerized by the Water Development Board in its work related to the completion and release of the

Texas Water Plan, published in late 1968. These data files became the nucleus of the Texas Water Oriented Data Bank. WODPS developed an implementation plan and schedule for expanding these files into an interagency data bank and began to incorporate data files from other participating agencies. Thus, commencing around 1969, the Texas Water Oriented Data Bank began to be operational.

In less than three years, the participating state agencies realized that the state should study the establishment of a more comprehensive system to include information on all natural resources data and not just water-oriented data.

This realization invites consideration of the question, Just what is water data? Those governmental and non-governmental entities which are concerned with water resources and are involved in competition for water usually run into difficulty limiting their definition of what is included in water data or water-related data. Consequently, the enlargement of interest by the water-related agencies of state government in Texas to the idea of developing a Texas Natural Resources Information System was really quite logical.

It is noted that operational development of the Texas Water Oriented Data Bank encompassed certain concepts that represented a departure from the centralized data bank approach. The National Water Data Exchange (NAWDEX) concepts were being studied at that time by the U.S. Geological Survey were explored and many were adopted as elements of the TNRIS conceptual design.

TNRIS links together the users of natural resource and related data with those entities which collect and store the data. It is not an institution dedicated to centralizing all natural resource data, but instead is a device seeking to tie together the information systems existing within the state and elsewhere in order to effectuate data delivery, primarily for users in the State of Texas.

Development and operation of TNRIS is guided by a Task Force, which I have had the privilege of chairing since its establishment. The Task Force is made up of representatives from 15 state agencies having responsibilities in the natural resources and environmental fields plus ex officio representation from the Governor's Office. It came into being in 1972 as an expansion of the earlier-mentioned effort involving eight agencies which had been working toward establishing a water-oriented data bank. In addition to supporting its participating agencies, TNRIS also serves other state agencies; federal, regional, and local governmental agencies; academic institutions; and the private sector. All services are rendered in accordance with a charging schedule approved by the Task Force. The schedule provides a generous allowance for TNRIS services without cost to its participating agencies.

TNRIS is an interagency entity having operating staff and computer support housed in the Texas Department of Water Resources. Its principal goal is to serve the participating agencies in order to facilitate the carrying out of their legislative charges. Related goals of TNRIS include providing support to planning responsibilities and operating needs of agencies involved in

developing, managing, conserving and protecting state natural resources; providing maximum availability of data and information; providing a multi-disciplinary approach for addressing participating agency statutory requirements and objectives; and reducing costs.

It should be noted at this point that the Texas legislature in 1977 again realigned the state's water agencies by merging the three principal agencies. The Texas Department of Water Resources is the agency that resulted from the 1977 merger.

TNRIS was not designed to take away control, nor was it designed to centralize everything. It has been conceived as a system to manage information, not as an information system to impose management. It manages information in order to enable the natural resource agency managers to function. TNRIS participating agencies know that their information system serves them rather than their being obliged to serve it.

This approach and this philosophy bear substantially upon the standardization that may be achieved by such a system. In the case of TNRIS, standardization has generally all been voluntary - after participating agencies have seen that it would be to their advantage to move in that direction. Data format and location code standardizations for readily computerizing many different types of data have been achieved without any dictation by the System of what techniques must be used by the member agencies.

As TNRIS has deliberately evolved, it has come to serve quite a large user community. The user community includes industries, individuals and private businesses, educational institutions, municipalities, county governments, councils of governments, river authorities, water districts and federal agencies. The principal mission of TNRIS is providing service to its users, whomever they may be. TNRIS service extends to assisting the users to procure whatever they need in the way of natural resources data, whether it is readily available through the computer linkages of the System or whether it must be searched out from inventories and catalogs of non-machine-processable material that may be located in a number of different places.

Some have been tempted, when seeking to embark upon establishing an information system such as TNRIS, to assume that they must prescribe in depth every detail of how the system must operate and precisely what will be included and what will not. Although advance planning is necessary, sufficient flexibility to allow for growth and development of the system based upon its demonstrated utility value to users is an absolutely vital consideration.

A good illustration of this consideration is the concern which was expressed when the Texas Water Oriented Data Bank was in the early stages of development. That concern related to the reliability and authenticity of the data which might be accommodated in the Data Bank. A few expressed the opinion that the Data Bank should seek to assure the reliability and authenticity of all of the data which it held. However, careful analysis revealed that there were water data files such as those on water use which everybody knew were not totally reliable or accurate, but which constituted important sources of

the best information available in a given area and consequently warranted inclusion in the Data Bank.

Basically, the organizational concept of TNRIS may be described as: a linked network of user entities acquiring and maintaining natural resources data; a "System Central" staff providing a point of contact for information on data availability, procurement and analysis; and a central facility to handle storage, retrieval, processing and, where appropriate, presentation of natural resource data and information.

There are 14 "Systems Central" staff members who serve the function of intertying existing state, federal and private sector information systems of importance to state natural resources data users. They coordinate the operational activities of the System along with the user contacts in each of the TNRIS participating agencies. The Systems Central staff members represent a wide range of disciplines and capabilities, and their coordination function is one of the major features of the System. The initial staff and computer support furnished to the Texas Water Oriented Data Bank by the Texas Water Development Board because of the statutory data bank charge to that agency led logically to a continuation of the same approach with TNRIS.

A true interagency character is prevalent throughout TNRIS activities and operations. The 14-member Systems Central staff is on the payroll of the Texas Department of Water Resources (TDWR). The manager of that staff serves at the pleasure of the TNRIS Task Force, although in all other respects, including day-to-day supervision of his work, he is a TDWR employee. The TDWR includes accommodation of TNRIS staff and computer support in the budget request it submits to the state legislature. The level of that support request is recommended to the Texas Department of Water Resources by the TNRIS Task Force. The TNRIS Task Force elects a chairman and vice-chairman biennially. The TNRIS Task Force secretary is designated biennially by the executive director of TDWR from the TDWR program area providing support to TNRIS.

TNRIS maintains a central facility with a variety of computer resources including a large-scale computer, computer graphics and microfilm capabilities, thus providing a wide range of services and products. These capabilities are available as needed for interfacing with the various federal systems. These include the U.S. Geological Survey's National Water Data Exchange (NAWDEX), Water Data Storage and Retrieval System (WATSTORE), National Cartographic Information Center (NCIC), and the Eros Data Center (EDC); the U.S. Environmental Protection Agency's Storage and Retrieval System (STORET); the U.S. Department of Commerce's National Technical Information Services (NTIS), the Bureau of the Census, and the National Oceanic and Atmospheric Administration-National Weather Service (NOAA-NWS); and the Office of Water Research and Technology's Water Resources Scientific Information Center (WRSIC).

Bibliographic data are available to TNRIS users through two online private sector sources: the System Development Corporation's ORBIT System and the Lockheed Corporation's DIALOG system. Access to data and information from

certain of the federal systems is accomplished through private sector contractors.

Many TNRIS data files are currently available through remote computer terminals employing a user-friendly system called the TNRIS Monitor. The Monitor is designed to be used by persons with little or no background in data processing. Monitor users can automatically be connected to other automated data files. Thus, data from several different files on different computers is available to TNRIS users by means of a single session on the TNRIS Monitor.

Some of the operational capabilities and services of TNRIS include: computer-printed reports; graphic outputs; interface with remote terminals; statistical packages; computer-generated microfilm; geo-coding/geographic information handling; analysis of remotely sensed data; catalogs/indexes; responses to inquiries concerning the availability of computerized data, aerial photography, satellite imagery/data, cartographic products, and technical publications; and ordering services. An additional service of TNRIS is the regular offering of courses to train users in getting the most from the System's various capabilities.

TNRIS indexes sensed, monitored, measured and collected data existing in both machine-processable form as computer cards, tapes and disks and in non-machine processable form existing as documents, maps and imagery. It also seeks to store selected data in a systematic manner to provide an information base. TNRIS disseminates data from the information base; refers inquiries to other data sources; and adjusts and organizes data into forms suited to storage, retrieval and analysis. It also functions in manipulating/processing data into graphic representations, models and study plans. At times its work leads to the development of specifications and simulation systems for natural resources management.

Included in its wide variety of different data types, TNRIS has a data base of more than 400 natural resources and related files, about 75 percent of which are automated. In one of the automated files there are in excess of 300 reels of magnetic tape. The non-automated files incorporate both published and unpublished data. In addition, TNRIS maintains a very close working relationship with the state libraries in Texas. Recently, an inventory of non-machine processable data files held by TNRIS agencies was conducted. The inventory, which will actually be a continuing effort as are the inventories of machine processable files, software and sources of natural resources expertise, has provided considerable input to a newly published update of the TNRIS File Description Report.

A key feature of all data files accepted by TNRIS is that a "responsible entity" is listed for the file. Any conditions or qualifications bearing upon the use of that file can best be and should be explained by the responsible entity.

In actuality, each provider of files to TNRIS is offered an opportunity to attach security provisions to files which it may contribute. These provisions in part, at least, grew out of the concerns that certain agencies had

for the ways in which various types of data, some of which might have questionable reliability, could be used by the uninformed. Utility value of data files has been the general criterion for their inclusion in the computerized file-holdings of TNRIS. It stands to reason that most entities do not seek to computerize a file unless they feel it has some reasonable expectation of fairly intensive usage. It follows, then, that most of the computerized files in the holdings of natural resource and environmentally-oriented state agencies should have a fairly high utility value. If the data are of questionable accuracy and reliability, they will likely be computerized only if they constitute the best such data available and must, therefore, be used.

TNRIS does a lot of computer processing of data and also, as mentioned earlier, provides terminal access to various users through 29 Monitor terminals. In this latter area, the System is providing terminal access to some of the regional and local governments. Such access is being provided to several of the state's river authorities and councils of governments, and some federal agencies utilize the system.

Some of the types of online files available through the TNRIS Monitor are daily and monthly National Weather Service and state agency precipitation, minimum temperature, maximum temperature, wind movement and pan evaporation data. Gross and net lake-surface evaporation state agency data, daily and monthly state agency relative humidity data, daily and monthly precipitation and evaporation data from the United States Section of the International Boundary and Water Commission, state agency coastal-zone biological information, and daily and monthly U.S. Geological Survey streamflow data are also among the online data files. Daily and monthly state agency suspended sediment-load data, and daily U.S. Geological Survey surface-water temperature and surface-water conductance data are also accessible through the Monitor. Additional files include state agency coastal-zone hydrographic information, USGS surface-water quality data, daily and monthly United States Section International Boundary and Water Commission streamflow, sediment load, reservoir content, and daily and monthly U.S. Geological Survey reservoir-content data. Texas Department of Water Resources' groundwater quality and water-level measurements from observation wells throughout the state are likewise available online through the Monitor.

A wide variety of map-related data is incorporated into TNRIS, some of which is stored in computerized form for analysis by the System. One of the major TNRIS efforts involves remote sensing-related and cartographic activities.

TNRIS remote sensing/cartographic activities can be classified into four areas: indexing and cataloging; data retrieval; education and consultation; and data analysis. As a state-level affiliate of the National Cartographic Information Center (NCIC), TNRIS has been engaged in an extensive indexing effort involving all known sources of imagery for the state, including federal and state agencies, universities and the private sector.

In its data retrieval activity in the remote sensing and cartographic area, TNRIS is assisting many users in procuring imagery and map data. The TNRIS computer terminal interface with the EROS Data Center and the 16 millimeter browse file of the Data Center's principal holdings are particularly helpful.

This equipment makes several hundred thousand frames of imagery covering the State of Texas available to TNRIS users.

In the data analysis area of its remote sensing and cartographic endeavors, TNRIS has been involved in a number of activities utilizing Landsat satellite data to assist Texas state agencies in natural resources related projects.

TNRIS has, with a high degree of success, endeavored to become a focal point for serving the users of natural resources information in Texas. Whether such service involved treading the federal maze in order to procure some needed item or simply providing the need from readily available TNRIS-archived material, the experienced Systems Central staff knows where to go, who to contact, and how to get what is needed and get it in a timely fashion. By the way, treading the federal maze, we believe, is far better than decrying its existence but doing nothing about it.

A total of 5,265 accesses of TNRIS files was made during the year ended May 31, 1982. These accesses were made by 1,053 different requestors. State agencies made 44.4 percent of the accesses, with the water-oriented agencies alone accounting for 36 percent. The private business and industry sector made 27.6 percent of the accesses; educational institutions, 10 percent; and individual citizens, 9.1 percent. Municipalities made 1.3 percent of the accesses, with the remaining 7.6 percent being made by county governments, river authorities, water districts and federal agencies. Computer terminals accommodated 9.5 percent of the accesses.

In organizing the data files within TNRIS, the TNRIS Task Force has defined six categories of data: base data (landmark data and man's subdivisions which serve as a supportive category to locate natural resources); meteorological resources (data and information related to all forms of climatological and atmospheric conditions); biological resources (data and information related to all living organisms as an aggregate); water resources (data and information related to all occurrences of water); geologic and land resources (data and information related to the constitution and structure of the earth, including land usage); and socioeconomic resources (although not purely "natural," these data describe inter-relationships between man, nature and man-made conditions). The major categories are subdivided as appropriate.

During the period of record noted above, TNRIS accesses by these categories were: meteorological, 313; water, 2,216; socioeconomic, 319; biological, 8; geologic and land, 4; base data, 1,582; and multiple category or general information accesses, 546. It should be emphasized that over 40 percent of these TNRIS accesses were in the water category and probably many if not most of the accesses in the other categories were water-related.

Periodically TNRIS, by means of a questionnaire, seeks input from its users on the degree to which the System has served their needs. Thus far, this type inquiry has been conducted three times. It is anticipated that it will likely be repeated some time during the next year.

TNRIS participating agencies include: Texas Department of Water Resources; General Land Office; Texas Air Control Board; Texas Forest Service; Texas

Industrial Commission; Texas Department of Health; Bureau of Economic Geology, University of Texas at Austin; Railroad Commission of Texas; Texas Department of Agriculture; State Department of Highways and Public Transportation; Texas Parks and Wildlife Department; Texas State Soil and Water Conservation Board; Texas Coastal and Marine Council; and Texas Historical Commission. The Governor's Office and the Texas Department of Community Affairs participate as ex officio entities.

Since 1969, the year when the forerunner Texas Water Oriented Data Bank became operational, TNRIS costs have approximated \$4.5 million. About 58 percent of this cost has been for manpower: 127 man-years provided by Systems Central and 42 man-years contributed by participating TNRIS agencies.

The existence of entities such as TNRIS, whether they be governmental or private, is justified only as they substantially help accomplish necessary, continuing, likely widely varying, but possibly to a degree repetitive tasks, jobs, assignments, responsibilities, undertakings, chores, work or whatever you may want to call them. How they help accomplish any and all such determines their importance.

Costs can be reduced as overlaps are eliminated and as procurement of needed data and information is facilitated. Coordination, interface and transfer of technology can be logical outgrowths of the operation of these entities.

In a sense, such an entity can at least assist the referees in the competition for water and other natural resources. The decision makers, whomever they may be, are better able to reach their judgments on the basis of reliable data presented in an understandable format by a neutral, unbiased entity.

The competition for water is intensifying amid a new or newly revived climate in which we all work and do business today. This climate is dominated by an extremely important and very demanding requirement. That requirement is to do more with less and to do it better.

Why am I inclined to feel that an entity such as TNRIS can offer benefits to those charged with doing more to resolve the issues of competition for water and other natural resources? Not only because of the number and types of user requirements which TNRIS is providing and to which I've referred herein, but also because many others seem to have thoughts along that line, also. An evidence of that is the visitors who have come to Austin in order to gain a better understanding of TNRIS operations. Over the past five years we have had visitors from Yugoslavia, Hungary, France, Argentina, The Republic of China, Korea, Australia, Sweden, Norway, Finland, Mexico, Nigeria, the Netherlands and South Africa. Representatives of 12 of the 50 states plus the United Nations and the Council of State Governments have also come to observe TNRIS operations. The Council of State Governments undertook a comprehensive case study of TNRIS which was published in the 1978 report Environmental Resource Data: Intergovernmental Management Dimensions. A great many of these visits and contacts were made in connection with a primary interest in water resources. Representatives from several of the states have visited TNRIS more than once.

I hope that I've given you a few thoughts on ways and means whereby a natural resources information system can serve as a referee of sorts in the intensifying competition for water and other natural resources.

Thank you.

Questions Addressed to Mr. Baskin

AUDIENCE PARTICIPANT: You mentioned a \$4.5 million budget. Does that include the equipment as well as the people operating it up to this particular date? I think it's 1976, is that the initial --

MR. BASKIN: The \$4.5 million cost would include a portion of the allocated computer costs for the supporting water agency over that period of time, yes, sir. I think, for example, that the current computer support for the system is running somewhere around \$350,000 per year.

AUDIENCE PARTICIPANT: What kind of growth in use or withdrawals have you experienced in the last few years?

MR. BASKIN: It's going at the rate of about 10 percent per year. We define growth the best we can -- that is, looking at it on the basis of the number of users and the number of accesses. Of course, as we all recognize, a given access may be for a piddling amount of data or it may be for an horrendous amount, but generally it's growing at the rate of 10 percent per year.

AUDIENCE PARTICIPANT: Who inputs the data? Does staff then get data from the different agencies or is there a person on a staff?

MR. BASKIN: In trying to answer your question I should try to clarify that we both maintain data files in TNRIS archives and we also index the availability of files in other agencies. In case of those files that are archived, our staff people will be responsible for entering them into the system with the assistance of the providing entity.

AUDIENCE PARTICIPANT: What kind of equipment is it and what kind of terminals is it that you have?

MR. BASKIN: I was afraid somebody would get into the computer end of this. I am not a computer-type man. We just installed in May some new Univac equipment. I don't recall what the model number is, and I can't tell you much about the terminals. Let me say that if any of you have any interest in details that I am not either equipped to cover here or fail to cover, I have left some material on the table out there, and a number of my business cards, a limited list of TNRIS publications, a one-sheet overview of TNRIS, copies of our most recent newsletter, and a few copies of the brochure on census capabilities of the system.

I am apologetic that I can't specifically answer your question, but the computer people tell me it's a high-powered gadget that we have and can do some amazing things.

AUDIENCE PARTICIPANT: Are user charges levied also against the member agencies for, say, data that do not come out of their own files?

MR. BASKIN: This varies a little bit. I have covered that rather hurriedly. I think I stated that we made a generous allocation or allowance to each of the participating agencies for things that they needed in the way of services from the system. There will be times, for example, when one of the participating agencies may want some, for example, remote imagery for a one-time project in which we cannot see any value for other participating agencies. So, if a situation like that arises, they may be asked to contribute substantially to the procurement of the data. We basically allow, as I recall, \$1,000 worth of services in computer time to each of the participating agencies, and then beyond that they pay unless it can be demonstrated it's to the advantage of all of the participating agencies or unless one of the other participants is willing to take an unallocated portion of its entitlement and divert it to the participating agency in need of funding for the items needing to be procured.

AUDIENCE PARTICIPANT: Did you say or did you mention about what percentage of the total cost of the system is contributed or paid by users outside of the member agencies, or do you have an idea of that?

MR. BASKIN: I am not sure of your question. Is it how much of our user services are reimbursable to the system?

AUDIENCE PARTICIPANT: How much money from outside of the system comes in by outside users?

MR. BASKIN: I think the latest figures run somewhere around \$30,000 a year if I recall correctly.

CONFLICT OVER WATER:
A WAY OF LIFE IN THE WEST

John Folk-Williams, President
Western Network

I am privileged to follow a speaker from the five great states of Texas. New Mexico is a mountainous state, and we entertain a lot of Texans there, but those of us in New Mexico seem to have ambivalent feelings about our guests and these are summed up by a bumper sticker that reads, "If God wanted Texans to ski, he would have given them a mountain." In addition to mountains, we have a little bit of water in New Mexico, not very much, but a little more than one of the five states of Texas which is called El Paso. El Paso seems to be running out of water. It is a large growing city in the Sunbelt. The city applied to the State of New Mexico, the state engineer, for a permit to pump out one of the basins on the New Mexico side of the border. They said no. El Paso is now suing New Mexico in a really major suit. I haven't seen the bumper sticker yet. It might well read, "If God had wanted El Paso to grow, he would have given it water." I think that gets down to a very typical Western situation. People are fighting about water all the time.

I have titled my talk "Conflict Over Water: A Way of Life in the West." One of the Western Network's intentions is to survey conflict throughout the region about this vital resource, and we have focused on three major issues, three major sources of conflict.

The first of these relates to American Indians and their very extensive water rights. I know it's not a problem you have. You don't have it in Illinois, but in the West, Indian tribes control a major part of the land base and have extensive and often unquantified water rights. Indian land is 12 percent of the State of New Mexico and 28 percent of the State of Arizona.

A second issue is the conflict stemming from the shift of water to energy development, which I gather is a problem you may have in this state, and the third relates to urban growth and consequent water demand. All cities follow patterns of growth that take resources from the countryside, and water is the first and foremost of those.

Listening to the other speakers I have heard many criticisms of water allocation methods. I heard a critique from a free market perspective, from an economic perspective, from a legal, an administrative, a bureaucratic, an information and research perspective, and a half-Socialist perspective.

All of the speakers have in mind an ideal model of the way things ought to work, and maintenance and exposition of those ideals is the stuff that advocacy is made of. These ideals give motivation to the constituencies. They express basic values. They make us function with some purpose in life, but the representatives of these groups never win in an absolute sense.

As we have heard, our system rarely makes drastic changes. It doesn't directly implement ideal programs. It always balances competing ideas because

it responds to the constituencies behind them. The competitors who succeed have to ask first, "Who makes the decision?" Then they compete for power over that decision-making process. The distribution of resources depends on control of the decisional process. Generally that means participation in it, influence over it, a kind of power sharing.

Now, those groups who do not organize effectively have no power and get none of the resource or else they have to beg for what they do get. Conflict about water in this general sense, then, can be thought of as conflict about control.

Water is what people get if and only if they have some degree of control. I am not going to tell you about how I think decisions about the resource should be made. We have taken a very empirical view. We are trying to find out what the elements of conflict really are and to catch some of the general themes running through the situations that we record. So, I will try to describe to you, however briefly, the way in which conflict about water in the West works and look at a few examples of how it's being handled, but keep your eye on where the control is and how power is being used.

In our survey of conflict about water, we have found a few ideas that work. Some of these address how conflict can be managed and how decision making can be improved. We are only about halfway through our work, so I am not going to make great claims for our perceptions at this point but we are beginning to see a few general principles.

First, conflict is permanent. It's a way of life in the West because the various constituencies have always known that control of water was an issue of survival, and that there generally isn't enough for all the users. You have to scramble to get what you need. Closely related to that is the fact that decisions about water in the region right now generally require a shift of the resource from one use or user to another. There simply isn't enough to go around. This is not just an issue that affects the obviously desert areas of the region such as the low desert of Arizona or New Mexico. It affects the most water-abundant area of the western states, the Pacific Northwest.

Up there, although you have incredible amounts of rainfall west of the Cascades and rather desert-like conditions in the east, even though you have the Columbia River, an enormous water resource, there are two uses that require water resources. One is the production of hydroelectric power which gives the State of Washington some 80 or 85 percent of its electricity and which depends on the impoundment of enormous quantities behind major dams. The other major use is fisheries and that, too, requires enormous quantities of water to remain instream and undisturbed so that the fisheries environment is not tampered with.

Now, a third principle we see emerging is that stability and decision making or dispute settlement is a crucial goal of most of the parties.

Stability means permanence in the degree of control of your water, whether that comes in the form of a vested property right, jurisdictional control or direct representation in a decision-making group, and it means reliable

access to water. Reliable access to water means delivery of the resource for use off stream such as in irrigation (agriculture in the West is almost totally dependent on irrigation), or to power plants or synthetic fuel plants, or to keep the water instream always for fisheries or recreation or navigation.

To the extent that any group is left out of a decision-making or settlement process, stability cannot be achieved. Water means survival for every group, and you can be assured that each one will fight in court, by referendum, in legislative halls or demonstrations, whatever crack they can get through to get a share of power. It's in the long-term self-interest of all to consider the needs of competitors purely to prevent serious disputes in the future which can disrupt their plans.

Although we can see this principle in operation, the gut reaction of every group in the West when it comes to water is to get what it needs and fight hard to keep it. Everyone else is kept out. We don't see recognition for inclusiveness in decision making, but we can see that when it is not observed, disputes are never really over.

Really, the model for most Western thinking and action about water was set by the City of Los Angeles as a tiny city in the desert in the 19th century. Los Angeles systematically took over the control of all hydrological units it might need for growth. First, it was the Los Angeles Basin itself. Then the San Fernando, and all the other coastal basins came under its authority. It grew as a city in terms of hydrological units, keeping far ahead of its needs for long-term growth. The city went hundreds of miles to the east to the Owens Valley and bought water and land and constructed an aquaduct that would take it into the Los Angeles water systems. Agriculture in the Owens Valley had simply to be bought out by Los Angeles to protect the city's waters in times of drought.

Los Angeles turned out to be a major owner of not only water, but land hundreds of miles to the east in the Owens Valley. Then Los Angeles officials turned to the Colorado River and began pressing in the 1920s to tap that source. That wasn't something it could do alone. They allied themselves with the farmers and land speculators interested in the Imperial Valley and other agricultural interests in Southern California. It also required federal aid. The Hoover Dam in the 1930s, the American Canal Dam in the 1940s, and another aquaduct wanted to take the Colorado River water, not only to Los Angeles, but to all the municipalities of Southern California now represented by an important entity in its own right, the Metropolitan Water District of Southern California.

In all of this search for water was the fact that control and diversion of the supply preceded by decades the need for the resource. That fact ensured that Southern California would always have what it would need for growth. It could become the major power in the region that it is today. The interest of Southern California in water has continued through the California State Water Project, and the Bureau of Reclamation's Central Valley Project is now tapping water in the northern part of California for use in the southern part of the state.

What emerges from that Southern California experience is not only a kind of dynamic control over water, but the re-emergence of large corporate entities such as the City of Los Angeles' Department of Water and Power, the Metropolitan Water District of Southern California, and many others. These have become typical of the region.

It is relatively rare in these Western water disputes to find farmers and owners of water rights as the primary suppliers. They are generally dealing with large corporate entities which have centralized control over great blocks of water rights that would include Indian governments and all the other districts and other entities that control the resource.

Which forces can have some power over decision making related to water? This sort of gets this out of the heavy political process of conflict that is generally engendered. Government has always had a major role in determining who gets water in the West. Water has been declared to be a public resource, not one that could be reduced totally to private ownership, but Western state water laws have recognized the ability of private citizens to use specific quantities of waters for specific purposes. These rights have been handed out in the past on the basis of historical appropriation, who got there first and actually put the water to use. This system, known as appropriation, was modified by the other system under which government declared certain uses of the resource to have higher priority than others. It described in law the idea of beneficial uses. Domestic water use is generally always protected, but until recently, a noneconomic use of water that did not require physical diversion of the resource, like preserving the instream flow from environmental protection, was not recognized. That is beginning to change in the region.

Further, new rights to appropriate water cannot be issued without proof that existing rights would not be impaired. These are the three major elements underlying Western water laws: prior appropriation, definition of beneficial use and the nonimpairment doctrine.

With those elements, the Western states began their institutionalization of the water rights regulatory system. Back in the 1890s a lot of Western states began to get very worried about the political fighting over water. They thought it would be better to vest decision-making authority in engineers, to take it away from the politicians. They wanted competent professionals to make judgments to resolve conflict about water and examine hydrological units for purposes of conservation.

So, the system is really one that is based on a principle, conflict resolution. People apply for a water right and hearings are held to see who is going to protest or whether the state engineer will determine whether conservation of the resource prohibits issuance of a new water right in a particular basin.

Yet, the state governmental role in water management is one that can always be supplanted by federal decisions.

The federal government used to own almost the whole region and established its proprietary right to that water by virtue of its land ownership. It

deferred to state water law voluntarily and never created a water right law of its own, but it retains the ability to intervene and establish federal standards when necessary. Congress has apportioned water of the Colorado River in certain states, established major purposes of the great reclamation projects, established procedures for allocating and contracting waters from these, and also reserved extensive rights for Indian tribes and for federal reservations such as forests and military installations. It also, through its reclamation program, mandated the creation of the conservancy district as an important water management and distribution agency.

...The debate about control of water usually relates to actions that government can take to allocate the resource, but economic change in the region is having another effect which is taking many decisions out of the hands of government officials, that is, the transfer of water as a result of marketplace transactions. The power of money is being felt throughout the West, and a permanent shift in control of water rights is taking place as energy companies in major cities, in particular, buy the water they need for their purposes. Unfortunately for the proponents for the free market, there are many constituencies who follow cultural rather than financial imperatives.

Indian tribes, environmental constituencies, ranchers and farmers: water is linked for them to survival of a way of life. A large corporation or a city, if it comes into a traditional community waving money around to bid up the price of the resource, may be asking for trouble. Some of the more farsighted representatives in industry have recognized this problem and are really abandoning a rather crude "cash only" approach and are trying to strike deals in the region where they accommodate some of the cultural and social values of the people from whom they are trying to buy water, but there is tension about whether or not government or private economic interests will predominate.

Remember, in our imperfect system there isn't any absolute victory. The messy outcomes result from some kind of a bargaining process. It's important to understand in all of this, as I said before, that the issue in these disputes is usually control, and not just the water itself. Western constituencies want long-term control so they can continue their communities as long as they wish. It may be forever for an Indian tribe, yet this sort of long-term security and control is not available through litigation or any method that omits consideration of management problems. Ultimately, some sort of consensual agreement is necessary either to end the disputes about the extent of water rights, to clarify jurisdictional rights over the resource, or to impose conservation requirements in times of shortage. But consensual agreements, whether they are achieved through mediation or direct bargaining, don't come easily.

For some, it's unthinkable to talk about negotiating about water. The term negotiation is equated with surrender by Indian tribes. It is linked to all that is held sacred. No constituency can be too quick to make trade-offs, because water is not something that can be exchanged with money or other types of assets. You need the thing itself, not just on paper. You need what we call "wet water." You need it on the ground, in the turbine, in the stream, in the city's plumbing; nothing else will do.

The fact is, though, that bargaining about water is on the increase, and the simple fact is that there aren't many alternatives. We can look at the most complex conflict over water that we have so far encountered in the West, and this refers to the Truckee Basin. The Truckee is a small river system that comes out of Lake Tahoe in the California mountains. It flows eastward down the east side of the Sierra Nevada into Nevada, and it terminates in another lake, Pyramid Lake, which happens to be surrounded and controlled by an Indian reservation. In the middle of the system is the City of Reno which is growing rapidly and needs water. At the top of the system is all of the development surrounding Lake Tahoe. It's important to preserve the level of water in Lake Tahoe, and California and Nevada have fought over that for years.

There is a conservation district which has provided water primarily for municipal suppliers. Farther down, Reno is trying to take water from the stream. There is a major division which takes most of the flow of the Truckee at this point out of the water from agricultural irrigation and then at the end of the line is the Indian reservation which is trying to protect the water of the lake for fisheries which is of cultural importance as well as economic importance to the tribe. There was, oh, 30 or 40 years' worth of litigation to establish a basic judicial decree in 1945 about the apportionment of the supply. Things got hot in the early '70s when the Pyramid Lake people watching the level of that lake go lower and lower and lower filed a suit against the Secretary of the Interior saying that the method of regulating waterflows in the system was depriving them of their water rights.

He had to issue new regulations. As soon as he did that, the agricultural irrigation district sued the Secretary because of precisely that: he was taking water away from them in favor of the Pyramid Lake people. The State of Nevada sued the Pyramid Lake Tribe to get ownership over the bed and banks of the Pyramid Lake itself, to have some control over what was going on in that system.

The upstream conservation district that provides municipal water sued the Secretary of the Interior because he was favoring the Indian and environmental interests. That district allied itself with the agricultural and urban groups and sued the Secretary of the Interior again because the alteration of stream flow was endangering a wildlife refuge which was really created by the overflow of excess water from the agricultural irrigation district. The Pyramid Lake people sued the upstream water users and EPA for failing to enforce water pollution regulations. And on and on it goes. We have only hit about half of the lawsuits in that situation.

That tends to be what you wind up with if you don't start to bargain in some kind of context. It may be bargaining with a view to legislation or an interstate compact or maybe just to reach a negotiated settlement over a relatively restricted issue.

I would like to refer to a couple cases of decision making where direct bargaining has been or might be used by the parties disputing. When Bill [Frerichs] first asked me if I would like to participate here, he said he would like me to talk about the use of mediation processes in the West relating to water, and I said, "Well, there just isn't very much of that going

on." It's true. Formal mediation has not been used. I think it might play an interesting role, but so far all that has been possible has been to get some of the parties in disputes to sit down at a negotiating table.

There are a couple of important themes that I would like to touch upon in looking at a few specific situations, and again I am going to be talking not so much about the technical water issues, but about some of the principles by which bargaining becomes a successful process.

First of all, if it's proposed to parties in a dispute that negotiation or direct bargaining among them might lead to a settlement, the very first question is to ask in whose interest is it that an ad hoc agreement about a particular dispute be reached. Remember, the issue is control. Up in the Columbia River Basin there are ad hoc negotiated agreements between Indian tribes and environmental and recreation interests and the federal agencies which controlled the release flows from the many dams in that system. The point there is again to protect the fisheries' environment. But, the management system itself continues to be dominated by a consortium of federal agencies. It's the best and most thoroughly managed water system that we have.

There is computerized tracking of weather conditions, water inflows, outflows. The dam releases are measured hourly in that system, but it's all in the hands of federal engineers and bureaucrats. The real issue for the Indian tribes and environmentalists is how to get into that management process, how to have long-term control over the system itself.

To propose in that context only ad hoc negotiation is to miss the key problem, to miss the point of control. It's not going to be settled by an ad hoc agreement every year. It's going to be settled by addressing the grander issue of how the system as a whole is managed.

Another key issue that has to be looked at once you have decided to do bargaining is how frequently the parties enter into the process. What has to precede any meaningful negotiation is a demonstration of power by every party. That may take the form of filing a lawsuit, or withholding water, or the Secretary of the Interior may issue regulations. Everyone is going to put on their strong suit. Nobody is going to bargain, if they have any sense, from a position of weakness, but sometimes it's hard to ensure that the negotiation process itself is free of coercion.

There is a big difference between coercion in the context of a negotiation and this sort of demonstration of power by all of the parties as they approach the process. Sometimes a formal mediator or third party can play useful roles as a kind of equalizer. I have in mind here the case of the City of Tucson which, like Chicago, is mining out the aquifers that are its only source of water. The City of Tucson is growing rapidly. The mining companies have large water demands in that region. Agriculture, irrigated agriculture, makes large water demands. All of these non-Indian entities have been pumping water out from the Indian lands.

The Papago Tribe was very poor generally in this array of corporate entities, but in 1974 the Papago Tribe filed a lawsuit against all of the non-Indian

water users in that basin to establish its right to a share of the water resource. That made everybody sit up and look closely at what was in front of them. It gave some degree of power to the Papago, but what Indians always face is relative powerlessness in Congress and legislative settings, and proposals were made to go straight to Congress to wipe out the Papago water rights.

The Congressman from that district, Morris Udall, who much to his credit has always recognized the legal importance of Indian water rights, resolved that a better way to settle this would be a negotiating process which would include all of the water users. Partly as a result of his discussion, a basinwide committee was set up to gather data, to coordinate planning about water use on behalf of all of the Indian water users and all of the non-Indian water users. Then he started the negotiation process. Being a Congressman concerned with the practicalities of the legislative process, he wasn't worried about having everybody sit at a table and adopt a set of ground rules and agree exactly on the nature of the outcome. He started to shuttle. He went from one constituency to another. He would draft legislative proposals, take it to all parties, give everybody a chance to react, and gradually he built up the consensus. He acted as a driving force there. I think without the intervention of a powerful intermediary, hardly a mediator in the formal sense, that situation would have had a different outcome. In fact, it might be in litigation at this point. It resulted in a legislative solution.

President Reagan vetoed the legislation embodying the settlement this June. He sent a team to Arizona to renegotiate those elements of the bill concerning payment of its cost, and it seems now that the bill will get through Congress and be signed this session.

Another key issue to think about in bargaining or negotiation concerning water is whether the ultimate issues of justice and equity and fairness are being discussed or whether the process is getting down to specifics. What we have found is that negotiation is a very poor forum for settling past grievances, for establishing what is fair and what is good. The minute those big issues enter into the discussion, it's almost impossible for any party in the dispute to make a concession. The whole process tends to work only when the participants can agree to get down to basics. Henry Loble, a negotiator in the State of Montana, has said we are not ecclesiastics, we don't sit around debating how many angels can stand on the head of a pin. We get down to how much water each party needs, where that water is coming from, who is going to pay for it, and so on. Unless the parties can agree to suspend some of their disagreement about philosophical issues or general legal principles or at least concede the validity of the opposing parties' views on some of these very basic ideas, it's rather unlikely that real progress is going to be made.

A critical and most difficult point to keep in mind is whether or not all the parties to a dispute are really present and spoken for. Here the physical geographical circumstances of the West make this a very hard job. Water has to travel hundreds, sometimes thousands, of miles in the region to get to its end use.

I would like to talk a minute about the situation that was caused by the ETSI pipeline project. Energy Transportation Systems, Incorporated proposed a coal slurry pipeline to take coal and water from the eastern part of Wyoming, in the Powder River Basin down to the states of Louisiana and Arkansas. The first issue facing ETSI was the State of Wyoming's legislative ban on the exportation of water, so ETSI had to go to the state legislature back in '74 and get approval for the exportation of water.

Then they started looking at the underground aquifer which was the water source for the pipeline. They wanted to pump from it, but it turns out it feeds a lot of ranches and farms. It also goes across state lines and affects ranchers and farmers in South Dakota and Nebraska. South Dakota threatened to sue the State of Wyoming if they allowed the exportation of water that interfered with their interests.

The local ranchers and environmentalists in Wyoming fought it for years. The State of South Dakota came in and said, "We have an answer to this. We have a huge reservoir on the main stem of the Missouri. It has lots of water. Why don't we let ETSI have 50,000 acre-feet of this water and avoid the conflict that we started down here by the attempt to pump out that aquifer." It seemed like an alternative approach. Of course, conflict resolution probably wasn't the ultimate goal. South Dakota wanted a lot of money for its water, but it was thought that this would be the way around the conflict.

South Dakota and the ETSI consortium made a deal, and the legislation for it was rushed through in South Dakota, and there was an enormous outcry. First of all, the speed and relative secrecy of the decision-making process until it got to the South Dakota legislature didn't allow for any input by any of the affected parties. Then, the legislative approval itself was rapid and was done in an atmosphere of pressure. It was all over before anyone quite knew what the implications of the deal were.

It looked like a pretty good deal from the point of view of the energy company, and I think ETSI is represented by one of the finest water lawyers in the West who has a very enlightened view on how companies ought to conduct themselves in water negotiations. The deal involved a relatively small amount of water from an abundant water source that would be piped across an area which needed rural water; those systems were going to be able to tap into the pipeline, and the State of South Dakota was going to get some money. However, the Missouri River, like the Colorado, embraces a lot of states, and a lot of territory downstream. The states of Iowa, Missouri, Nebraska were very alarmed that the precedent established by this ETSI deal could lead to much more massive exportation of water from the South Dakota reservoirs which would threaten the instream flow necessary for river traffic in the downstream states. You have a number of Indian tribes whose lands had been flooded out to create those reservoirs and who are now beginning to assert their water rights. Some of the tribes were interested in marketing water, too, but they wanted to make sure that South Dakota didn't sell the water before they could get to it. Some wanted the water for use on their own lands. The result is that we have a new lawsuit filed by both the Indian tribes and downstream states challenging the validity of that South Dakota water sale.

What started out as an effort to sidestep conflict precipitated a vast regional or inter-regional conflict about the allocation of the Missouri River water. The only way out of that now, it seems, apart from some sort of legislative solution, is to have all the states enter into a negotiation process to come up with a compact involving the allocation of water among the states along the stream. That could be a decades-long process.

One of the most important principles about this resource that has to be kept in mind is that every constituency wants to have power however the decisions are made. Nobody in the West wants the water decisions made entirely in Washington, D.C., and local participation is absolutely essential to ensure an equitable result.

Discussion of conflict management really gets to the heart of who has decision-making authority relating to water. Our research leads us to the conclusion that all of the constituents have a vested interest in stability in decision-making processes, and stability is made possible to the extent that all competitors negotiate in these decisions. Those left out when key decisions are made have no choice but to fight because their very survival may be at stake. You can be sure that they will be at the front lines to make sure they are not left out of the action.

The West is still learning how to cope with conflict about water. Once it was thought engineers could make the best decisions, but these states are now entering a phase of reallocation, the problem of taking water from one party to satisfy the needs of another. That has to be achieved by a political concession or by consensual agreement achieved by hard bargaining.

The State of Illinois is to be commended for dealing with this before the issue is so highly charged as it is in the West. Although the West is different, its experience in decision-making is applicable elsewhere, and I hope that your state can learn from that experience. Thank you.

Questions Addressed to Mr. Folk-Williams

AUDIENCE PARTICIPANT: It occurred to me that the problem you are describing out West is almost the opposite of where people in a locality don't want to see a regionally beneficial, but local, facility in their community. Here you have people that could be separated by hundreds of miles imposing sanctions on each other. It doesn't seem to me that we have the political institutions to bring those people together.

I am wondering if at this preliminary stage you have some idea how we could draw together those diverse geographic interest groups to reach a consensus.

MR. FOLK-WILLIAMS: There is a common interest that those widely separated groups share and that is management of the basin as a whole to ensure long-term conservation of the resource. It's true that the institutions are not there by and large right now with the possible exception of the Columbia River Basin, and we certainly have even less groundwork for interbasin

coordination. It's really a matter of working with groups to look at what their own long-range interests are. Most of them, in addition to the stability issue that I was talking about, also want the resource to be there forever, and the only way that can be achieved is by a more comprehensive approach to management. What is needed is interjurisdictional cooperation, whether between an Indian tribe and a city or Indian tribe and a state. This is a very hard thing to achieve even between states, but that isn't there by and large right now.

AUDIENCE PARTICIPANT: This is for John, and sort of following the last item. It occurred to me that the problem you are describing out West is almost the opposite of where people in a locality don't want to see a regionally beneficial, but local facility in their community. Here you have people that-- people could be separated by hundreds of miles and imposing sanctions on each other. It doesn't seem to me that we have the political institutions to bring those people together.

A SHIFT FROM WATER DEVELOPMENT TO WATER
MANAGEMENT: THE TREND IN FEDERAL INVOLVEMENT

Warren Viessman, Jr.
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I am pleased to be here today. What I have to say is strictly my own opinion. They are my views, not to be construed as any views of any Member of Congress or any committee, although I do advisory work for the Congress.

Let me first start off by saying that most of us who have worked in the water resources field for a long time know what we all work under: some kind of pressure or adverse conditions. It brings to mind a little story that I have about this Indian who came out to this farmhouse and decided that he just couldn't go any further. He said to the farmer, "What can you do about renting me a room?"

"It just turns out that I am all booked up right now. There is no place to put you."

He said, "How about that stable that is over there?"

The farmer said, "No, I have already rented that out."

He looked around and saw this outhouse. He said, "How about that?"

The farmer said, "Do you want to rent that?"

The Indian said, "Yeah." So, he took it.

The farmer was out working in his fields, and he noticed there were two television antennas on this outhouse. The farmer kept working, and it started to get to him. He couldn't believe that here was this little shack and an antenna. He said to the Indian, "I don't want to pry into your business. I don't understand how you could have these two antennas."

The Indian said, "One of them is for me and the other is for two hydrologists of the Water Survey that I rented the basement out to."

So, you can see you are out collecting data and you are working in the field, and you have to put up with that kind of stuff.

Another thing I find interesting about this area. I run. In the last two mornings I have gotten out before dawn, and everything is flat. Where I live and run there are all these hills you have to go up, and it really feels terrible going up them. It isn't bad here. Everything is level. I have enjoyed that. In fact, I wish I could stay a few more days or else take that level area back with me.

Before I get into my formal remarks: I have taken notes over the last few days. I have found this to be a very interesting meeting. There are a number of divergent points of view. There are a mix of people I have found that are very enlightening. A lot of things said over the last two days are very appropriate to the problems we are facing. Some of them, which have key words involved in them, are directly related to my own views and ideas about some of the water problems we will face.

I am going to give you a very short summary of the meeting up until this point, and I will apologize to all of the speakers for saying things that I think that they have said. Maybe I am misinterpreting it; if I said it wrong, please excuse me.

Michael Witte started out, and he said something like solutions to many resource problems mostly come from the condition of the governmental arena. I think that is true. Technical solutions which are operating outside of social and political areas are almost doomed to failure.

Don Vonnahme said, "Don't apply the fix now," I put this in quotes, "but only where you have the problem." What he is saying is our approach to uniformly regulating everywhere is wrong and bad, and certainly a very inefficient economical approach. There is a need to look at regionalism and localism in problem solving. He also said that water problem solving should be approached in an objective manner. I think that is the key word, and it's central to the theme of things I will tell you.

Betty Lou Reed. I found her talk most interesting. She said technical staff rarely face problems of implementation. That is it right on the head. Too many technicians know what ought to be good or have good ideas on what ought to be good, but they simply operate in a realm which is either a black magic thing to the politician, or the people on the line don't understand, or they are unable to communicate. She also said that the burden of institutional change is on the citizen, not the institution. I think that is also fundamental to some of the water problems we face. If we wait around for the institution to change, we are in trouble. We, the citizens, have to bring these changes about.

Fred Powledge stressed the competition, which I will call the "allocation" problem for dimensions of the water resources issue. It has been said over and over again. The previous speaker talked about this allocation issue; the afternoon panel discussed localized water problems. They were all in the context of various kinds of conflicts and options that might be exercised and resolved in people, technicians and others.

Barry Commoner indicated that national policies could be redesigned to re-district agricultural and institutional policies to achieve what I would call limited goals of these sectors in a more economically efficient and environmentally sound way. Interestingly enough to me, having heard Barry speak a number of times, particularly years ago when the environmental movement was what I would call at its peak, I found one thing very interesting and I think it's something that is encouraging. It seems to me that many people whom I would classify as ones who have been very hard-core environmentalists,

and others, are starting to become, I would call, more mellow and more able to rationalize and work with others in trying to resolve these problems.

I don't know if I am saying it badly or not. It seems to me that Barry is saying that there are problems that can be solved by different means and he suggested several of these, but this doesn't mean that we shouldn't do some of the things we want to do, but we can do them in a different way. I think that is a good approach and certainly something that is needed.

Bill Frerichs indicated the need for an alternative future for protecting future values. He said a new breed of bureaucrats is needed. One that can change and educate. I can say "Amen" to that. Too much of the problem stems from the fact that the technical ability and technical representation of facts is simply incomprehensible to those making the decisions. He also said there is a need for truth and understanding in promoting efficient water management. I think that is a very fundamental statement.

Mr. Baskin discussed the importance of good data policy. Don't be misled. These I think are important to good decision making. If you look at the problems of data even in a rather gross sense - 1975 assessment of the Council, the United States Geological reporting of data, the state reporting of data and others - it's interesting to see the wide disparity of reporting for a single variable at a particular point in time. These are now supposed to be historic data. It's interesting to me in some of the work that I have done to find that even the history sometimes is hard to pin down, depending upon what agency is reporting that history.

John Folk-Williams stated that conflict is permanent. He noted also the allocation, or more specifically the reallocation, problem. I think that is a very fundamental thing today. Obviously, what we are really talking about in part is allocation or reallocation. He cited the need for all participants to be involved in decision-making processes if any real stability is to be achieved, and the important point was the increasing role. An important point I felt he made is the marketplace transactions in water resources, allocation and reallocation.

There have also been comments made in the last couple days and these are the comments you hear over and over again in the newspaper and other groups. These are the familiar comments of the great waste resulting from water resource problems and perhaps one way to get around the economic problems of today is to start right off with the tougher look at water resource programs, development condition, instruction, management, whatever.

Certainly I would not deny that there has been waste and error in the water developmental problems in the country since the beginning of the century, but perhaps more of us should look at some of the benefits that have resulted from the efforts of our predecessors, remembering, too, that their work was without the knowledge of today's world and the attitudes that we know and talk about here at this meeting today.

I think that in this regard the following quote which was made about 70 years ago by Theodore Roosevelt is very appropriate. He said, "It is not the

critic who counts, not the man who points out how the strong man stumbles or where the doer of deeds could have done them better. The credit belongs to the man who is actually in the arena, whose face is marred by dust and sweat and blood, who strives valiantly, who errs, and comes up short again and again because there is no effort without error and shortcomings."

With that as a beginning, let's now take a look at some further issues.

The early years of the 20th century were building years for water projects and programs, but since the 1960s the pattern has shifted and an antagonism toward water resources development has settled in. Perception of water problems, acceptance of ways of dealing with them, political maneuvering to get water projects, definition of beneficial uses of water, and administrative procedures for dealing with water supply and wastewater disposal have all undergone rapid change.

Furthermore, it is interesting to observe the disproportionate share of blame for inefficiency, "pork barreling," and environmental destructiveness which has been laid on water projects and programs. Of course, there are such programs that have taken place, but when measured in dollars - and it seems that few people seem to recognize this, the total expenditures on water resources, water quantity and water quality constitute only about 1 percent of the entire federal budget.

Now, if every dollar that has been spent in the past on water projects was in fact a boondoggle and a waste, that is still 99 percent efficiency in use of federal dollars. If only all the other programs were that great. I assure you that you could find many, many more percentages in deficiencies in other programs that are hardly ever talked about, yet water resources has historically been singled out over and over again as a scapegoat for inefficiency.

The environmental movement of the 1960s ushered in bold legislation on water quality control, and at the same time, citizens began looking more critically at the tradeoffs between water programs and those related to education, crime and social services. The once powerful political blocks of Western congressmen were weakened under the fire of Eastern coalitions that felt they weren't getting their fair share of the dollars and weren't getting their fair share in the projects and activities that federal involvement should make in water resource programs.

The list of these things goes on and on. During all of this period of time, the only constant has been the resource itself. Floods, droughts and pollution have marched on as always. What did change radically was the focus. It shifted from the technical issues of hydrologic systems - physical, biological and chemical factors of water bodies - to issues of human behavior, those associated with the presence of man and his activities.

Today the need for objective - and I underscored that - planning and management is compelling. The question is how to pull it off. It is not a matter of technology. It is a matter of human-agency-government-interest group interrelationships. And, it is systematic of the pervasive institutional problem which is at the bottom of all water issues. The fragmented

power systems which must be dealt with in this country - state, federal, local, legislative, executive, judicial - present more of a challenge than most people are willing to take on or even consider.

Isolationism in dealing with water resources issues, influences of laws and regulations, political boundaries, agency missions, financial barriers, social customs and the belief that water is free for the taking have all interacted to create what I would call a "water crisis" aura. It is unfortunate that these human aspects of water management are so sensitive that politicians and others avoid addressing them with the hope that, if left alone, they will go away.

Instead, as the situation deteriorates, technological refinements and evaluation procedures are argued about because they generate controversy of little scale and can be made the scapegoat for indecision and inaction. In my view, for example, the countless days, hours, dollars that have been spent on principles and standards falls far short of the real issue. It is not the technical evaluation of projects that should lead us into making the water resource decisions. It is the need for development or management and the prioritization of the problems that we face, not the technicalities of how to design or construct.

These are relatively straightforward and should be considered in all kinds of engineering and design programs. An important point is that in many cases, and I believe in almost all cases, water is physically available, but locked out of use by laws, regulations, traditions, imperceptions, and other institutional mechanisms. Unfortunately, the institutional elements of water management all have a common thread, and it is emotion. It is this feature with which we must contend if we are going to use our know-how effectively.

Our levels of technological understanding are sufficient to allow us to present viable alternatives for handling the tough issues. Our shortcoming is in our inability to implement solutions which are suggested.

We as a nation are technologically rich, and our level of accomplishment is high and sophisticated. But we as a human system are floundering at an elementary level, with perplexing interpersonal, intergovernmental, interagency and related problems which strive and mold our decisions and which seem at times to eliminate all options for achievement except those created in a scene of a crisis.

This is not an easy society to live in. The rate of change in its technological dimensions has been swift and mind-boggling, and these changes are accelerating. Many of the institutional elements, on the other hand, are old, have not kept pace with other shifts, and are tied to policies of days gone by. The tug of war this creates is intense and debilitating.

Furthermore, we have generally been approaching the problems we face in the wrong way or at least in the way which minimizes our chances of success. For years it was recognized that some type of regional planning was needed to bring about a cohesive type of development. Unfortunately, the failures of regional organizations which were created to do this job are legion. The

lesson is that needed changes are not going to occur unless there is strong incentive for them. Most reforms will require compromise at best, and loss for some of those involved at worst. Few panels will ever recommend a course of action which is detrimental to any of its members. What is needed is a mechanism by which objectivity can be brought into decision-making processes on a sustained basis. Unfortunately, our approach to objectivity has been undermined very significantly in recent years by political and social pressures.

What all this comes down to is that planners and managers of tomorrow must be of a new breed. Being well-grounded in technology is not enough. The strict technologist looks for the best technical way out of a problem. He does not always stop to look to determine if that particular approach might go counter to local traditions, cannot be accommodated within a prevailing legal system or would negate some other desired activity. We must design, manage and plan within the context of existing physical and institutional dimensions. Otherwise, our proposals will fair poorly, and we will risk the loss of even a step-wise solution.

On the other hand - this is important - we must take every opportunity to show the gains which might be achieved by lifting some or all of the constraining influences. Information of this type laid out in simple terms is sorely needed. If it is presented often enough and well done, it will eventually be listened to. I say this despite Hanke's quote that Balzac's statement goes to the point that one does not enlighten the government. I think that it is possible to enlighten the government. I think many people believe that it's impossible, but in the eight years that I have worked with the Congress of the United States I have found that not every member of the Congress is simply out for his own good, to fill his pockets with gold or whatever, or to party, but that many of these people are hard-working. They try to be on top of issues. They try to understand, and one of the great problems that they face is being able to obtain timely, accurate, understandable information and certainly many of us who work in the technical field can feel very badly about the nature of the information and the timing in which it is provided. Often it is simply in a form that does not lead a decision maker down the path that we would hope he might take.

Given the pressures to provide water for a myriad of uses, and given that there are strong social pressures to do all of this with minimal structural undertakings, and in a way unlike that before, I think the door is now open for more imaginative management operating outside of the narrow perspectives of agencies, interest groups and others. The tools of diagnosis and evaluation at our disposal permit prompt, in-depth evaluation of many courses of action, the alternative futures that were talked about here earlier. It is time we started to objectively examine systems already in place to see if they can be operated more efficiently, and if so, what changes would be needed to bring about these more efficient operations. For example, analysts have found a way to forestall the need for additional water facilities in the Potomac River Basin at least until early in the next century. This is done by optimizing the releases from existing reservoirs.

Studies such as this, I think, have great promise for taking on problems all over the nation. To me there is no question but that we will have to shift more attention from construction development to improved management. I think there are many opportunities through management devices to improve significantly on the amount of water that can be made available and to relieve some of these problems of either allocation or reallocation.

Let me just take a moment or two to talk about this Potomac situation. For years and years the water resources of the Potomac have been argued about. The big problem is the water supply in the Washington metropolitan area. There is a drinking water problem. If you look at the natural system which is pretty much what is there today, there are periods of high and low needs. As the population of Washington increases, more people are there, and therefore the low-flow period became more critical in terms of water supply. Technologically, the way to get around this is to provide storage through reservoirs. By and large these have been fought over the years. There were a few built, but not many in the last two years, probably the last dam on the Potomac to be built for many years was the Bloomington Reservoir. This was conceived about 25 years ago. The reservoir was closed and some great young systems people looked at this river system and looked at the Bloomington Reservoir and several other reservoirs that are in Maryland and Virginia.

I wondered if we could operate this system as a system during low flow periods and provide additional water over what it now has. The systems people found that in the lowest flow period ever recorded, but operating, this is a single unified system in terms of releases, that a 25 percent increase in water availability could be obtained. This is very, very significant. This is not at the cost of construction of new reservoirs, but simply by injecting an operating policy during that period of time.

This is the kind of imaginative approach to problem solving that I think is needed. It involves cutting across political jurisdictions. It resulted in something else in the Potomac. It resulted in an actual legal document signed by all of the parties to agree to this mode of operation. It did not impose a new regional authority. It didn't supplant any of the prevailing governmental systems, but it got them together legally and brought about this unified management, at least under these conditions. This is very important, and this is to me very enlightening, and it's the way, I think, of the future.

The institutional problems I have talked about very briefly, and they are particularly troublesome. They include, among others, the conflicting purposes of state and federal water laws; the proliferation of water agencies; the ill-defined roles of federal, state and local governments. The enormous body of environmental laws and regulations which have been produced in recent years is also troublesome. Federal agencies and the courts have foreclosed the construction of beneficial water projects. Furthermore, various laws and regulations have sometimes been used inappropriately as tools to derail or delay water and other types of development.

There has been a good deal of talk in the Carter Administration and also the Reagan Administration about turning more and more responsibility back to the

states, and this is something that I think is important. I think that it is in the wind and certainly it has begun to take place, but it will have to take place over time. The federal role, as I see it, is not going to disappear in totality. It's going to shift, and there may be fewer federal dollars. There will be a federal role to play, certainly, in terms of information collection and of consultation, technical advice, and possibly even in terms of guaranteed loans, low interest loans, and others.

Some of the other, what I would call up-front, issues before the Congress include water quality. It doesn't look like anything is going to happen this year other than groundwater management, urban water supply, the rehabilitation of these water systems, water allocation issues, conservation of water resources, coordination of water programs, water policy assessment, cost sharing and financing of water projects, coal slurry transport, reclamation reform and determining adequate drinking water standards of the Safe Drinking Water Act.

All of these topics are considered by both the current Administration and the Congress. What the future holds is hard to say, but it seems clear that the emphasis will be on water management and less on the construction of new facilities.

Now, in the final analysis, the severity of water and other crises we may face as a nation will depend heavily upon our ability to be society-wise as well as technology-wise. Only then can our creativity, imagination and technical underpinning unlock the constraining mechanisms that force us to operate far beneath the level of efficiency for which we are capable. This is the challenge, I think, that we face. If it is not accepted, the frequently referred to water crisis will become a reality not because the water is not there, but because we are unable to get our act together to be able to reallocate or allocate or provide that water in efficient terms.

I think that we should take the approach of not simply spending our time looking at the past, but looking for directions in the future. It's easy to see a crisis in hindsight. Some of them have been bad, some of them have been good. Economics of them have been argued about for years, but if the economic evaluations or the interest rates that are proposed today had been imposed years ago in some of these projects, some of the things that were built would not have been built, and we would have been the losers.

The Potomac River is another case in point. The Bloomington Reservoir was built at a time when the interest charge was 2 5/8 percent, and someone said in the last few days these low interest rates simply brought about pork barrel projects. Well, the fellows that work on the analysis of the system and the way to operate this system more effectively have stated very clearly, and it's obvious, that without that one reservoir there would be no way to enact this kind of a new system operating policy and, in fact, the only resource then today would be to rebuild another dam at a much higher construction cost and interest rate.

Certainly, the designers of the Bloomington Reservoir never had this in mind, but I think the people in the Washington metropolitan area will be thanking

their stars for years to come for the decisions that were made, even though that reservoir in that particular project carried an interest rate which would be looked upon with some disfavor today.

I am very glad to have been here today. I thank you very much.

Questions Addressed to Mr. Viessman

AUDIENCE PARTICIPANT: Mr. Viessman, I would like to ask you if you feel, under the current climate of reduced federal expenditures of our national debt, that we ought to continue water projects that have built into them these large subsidies, let's say, even for financing the project.

MR. VIESSMAN: No. No, I don't think that. I think that irrespective of the problems that we face in this nation now in terms of our economy that this does not rule out the need to build some projects which may be the only recourse to solving a local or regional water problem. This isn't to say that these projects should be formulated with large subsidies included or that, in fact, the federal government should pay all of the costs. It doesn't speak to the point of how the cost sharing should be taken into consideration. What it does, though, is say to me that water resources and their management are vital to the wealth of this nation and, as someone pointed out yesterday, that sooner or later the piper will have to be paid.

In some cases we can get around the problems we face by management or conservation or other techniques or doing nothing. In other cases, there is no question that ultimately there will have to be some structural developments made. These have to be faced. The time lags in planning, designing and constructing are very long. If these aren't faced up to today, our children or others will face these in the future.

So, I think, that regardless of the state of the economy, considerations have to be made for water and other kinds of development. The point is to assign the priorities to these projects. My only conception is that our past system of prioritization for water projects was really bad. It's been a political thing where a local constituency brings forces to court. In order for our system to work better, it is going to mean, I think, some fundamental changes in the way that Congress looks at these things.

To me the congressional kind of decision should be made in terms of what are the pressing problems and how funds ought to be allocated to solve those problems. The lesser decisions then are the particular plans and means for meeting those objectives, and they could be made at a lower level.

AUDIENCE PARTICIPANT: Can I ask one other question? Is it your feeling that in a major water project it is wrong to require in that authorization, let's say at the federal level, for the agencies to consider the other values, let's say, the environmental values, and make decisions in accordance with those to minimize the damages on other values that might occur as a means of water development?

MR. VIESSMAN: It is absolutely not wrong and, in fact, it is absolutely illegal if you look at all of the statutes on the books that, in fact, impose an environmental consideration on water projects or others. I mean, this is the law, and so this has to be done. I think that if a water project or any other project of a public works activity is to be undertaken, obviously the environmental consensus of that should be evaluated. There isn't any action in an engineering sense. There isn't some kind of implication. The point is that that project or whatever its benefits will be simply outweighs some of the environmental consensus. Obviously, if the environmental consensus is so severe, then the project shouldn't be built or other alternatives considered.

I think we must look much more objectively at how we solve problems than simply say that what we ought to do is build something to provide additional water storage or supply. I think in many cases we can do this or increase the validity of water through other techniques which requires institutional coordination and cooperation. That is very hard to bring about, but certainly we should not lose sight of the environmental values. I don't want to convey, and I hope I haven't conveyed, any attitude of that nature to you.

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WATER RESOURCES IN THE 21ST CENTURY

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It has been said that the subject is "Water Resources in the 21st Century." That is only 18 years away, and because my real area of interest and expertise in the past has been in energy, I will talk about the late 21st century. Nobody will know for sure if I am right or wrong that way!

When we shift our focus from the present to the distant future, we are doing what a scenic photographer does when he changes from a wide-angle lens to a telephoto lens. Although the photographer does get a clearer view of what is at a distance, at the same time he sacrifices his ability to include the foreground in the picture. The perceptive photographer realizes that this disappearance of the foreground can leave the viewer feeling disconnected from the resulting image. So the photographer finds a way to include something in the midground to help connect the distant image to the viewer to provide a link that clearly establishes the perspective. It makes for a more powerful and meaningful photograph.

As we consider water resources in the 21st Century, we need to clearly recognize that they are the very same resources that we have talked about for the last two days. We need to realize that the quantity and quality of those distant resources are influenced directly by what we do today and also, unhappily, by what we have already done.

This means that in the future we will have fewer choices open to us, and in a very real sense we have already made choices by default for our future. The difficulty for us today lies in imagining how those choices will affect our future. Certainly, it would be easier to send a few journalists there--Jim Krohe [of the Illinois Times] perhaps--to send us back information on what that future would look like.

Actually, we know quite a bit of what our water resources will look like. Barring tremendous changes in climate, we in Illinois can expect to have about the same share then as we do now of the globe's estimated 326 million cubic miles of water. We can reasonably anticipate that the legacy of pollution will still be there. There will be groundwater aquifers contaminated with substances that may be presently in them. Some lakes and rivers will be underlain with contaminated sediments.

We also know where our water resources will lie. Here in Illinois we have been collecting data on water resources for over 75 years. We have reliable information on aquifer replenishment and a body of climatological knowledge, and there is a sound knowledge of hydrologic information on rivers, lakes, and reservoirs and impoundments. We of course do not know nearly enough, and our scientists, particularly in my agency, thirst for knowledge. That thirst is deep, and they will continue to seek it.

There is a tremendous amount, however, that we do not know or understand about water. When scientists describe the chemical and physical properties of water, one of the most frequently used words is "anomalous." It does not behave in the way some chemicals do.

We have been surprised many times by our lack of knowledge. Once we could be confident about how chemicals would move underground. We used to be fairly sure of the diluting powers of our rivers and lakes and how our natural systems would purify our water resources, but the rapid changes that have taken place in our society since World War II, as Dr. Commoner alluded to yesterday, have posed a new set of questions for us. The process of answering them is disturbingly slow and we do not like some of the answers we are finding.

I said yesterday in my opening remarks that I had learned a few lessons regarding natural resource issues. One was that solutions to our research utilization problems lay ultimately in the political process. Nothing I have heard in the last two days changes this conviction. I am not saying, as we suggested earlier this morning, that our solutions be necessarily governmental. But, in Illinois at least, the future of water resources in the 21st Century will be forged in the political process. Whether it be a comprehensive revision of Illinois water law, deregulation of most aspects of water supply, imposition of a massive system of mandates for water conservation, or--as our keynote speaker suggested yesterday--public participation in the determination of industrial and agricultural technologies, the choices will be made in the national and state political processes.

Just as our past choices have dictated our present conditions, so will the choices we make in Illinois shortly in the rest of this decade profoundly influence our water in the 21st Century.

But yesterday I also said that I have learned another lesson. I will repeat it again: In this increasingly complex world, wise decision making is dependent upon reliable data and information. Data, information and analyses that scientists provide us absolutely cannot substitute for, or dictate, the political choices that will ultimately be made. They can at least cast light upon our options and upon those options' probable effects.

In Illinois we can be justly proud of our long record of scientific inquiry regarding our water resources. The State Water Survey, with which I am really proud to be associated, has probably compiled more data on Illinois water resources than the data available on water resources in any other state. However, I think that Stan Changnon will agree with me that these data are woefully inadequate compared to the questions that we'll need to have answered.

Let me cite a few examples. In Illinois we do not have an extensive and systematic benchmark data network allowing us to routinely monitor changes in quantity and quality of our resources. In Illinois we do not have the kind of stream and lake sediment monitoring program necessary to allow a thorough understanding of the conditions that contribute to, or the management

practices that will help us allay, soil erosion, the biggest problem in our state.

You heard about the remarkable strides the people in Texas have made with their natural resource information systems. In Illinois we have compiled more data on our natural resources over a longer period of time than any other state, but have not yet developed an information system to use the data. Although we need more data, comparatively speaking, we are rich in data and poor in information in Illinois. Information, the result of interpretation of data, is the key to unravelling our natural resource problems.

I don't mean to sound pessimistic; I am not. But the three examples I have just cited are symptomatic of the problems we have mentioned repeatedly in this conference. How do you focus public concern, and ultimately political concern, on such problems in a state where water resources are so abundant and where public perception of the emerging crisis in water is low?

I think you will all agree with me and our speakers that the answer is education of our public and political leaders. Everyone in this room, regardless of the individual solutions you will bring to the water crisis, shares this responsibility. I think the media, in particular, must recognize this responsibility.

Computer technology is supposed to increase our capability to gather more facts. We have already seen it working. With the help of computers we have come a long way in coming to grips with other natural resource problems, namely, in energy. For the first time we have the ability to see the full ramifications of an energy choice all the way through our system.

Computer models in energy currently let us detail both the direct and, perhaps more importantly, the indirect energy costs of building a power plant which will use coal as a fuel. We can anticipate the cost of mining coal to fuel the plant, the energy costs of fabricating barges or trains and track to ship the fuel, the energy costs of operating that transportation equipment, the energy costs of constructing the power plant, of shipping its components and the energy costs of distributing power to consumers.

The trouble with this situation is that we have not yet come to grips with the enormous difficulty of matching that capability to manipulate very complex data with the need to make real time decisions. The ultimate difficulty remains: technological virtuosity must be meshed with humanistic values. Illinois will eventually have a natural resources information system and its goal will be to make information, not inscrutable data, available to all who have an interest in natural resources, not just a few.

In the 21st Century, if we have succeeded, we will be asking what are the "water costs" of the activities of society, much as we are beginning to look at the energy costs of our activities. In both cases, unfortunately, I suppose we will first have to agree on some sort of value system. That task will be made more difficult by the arrival of what is called widely in the press these days "the Information Age." We will have accumulated so

much empirical data about so many areas of concern other than water that there will be unprecedented competition for our attention. The wealth of information will breed staggering complexities.

Mankind, it seems to me, suffers from a peculiar and frustrating problem. The more knowledge we gain about a matter, the more necessary decisions we see that absolutely must be made. We are constantly making choices that seemingly must be made now and that seemingly are inevitable, given what is known at the time. Yet, these choices often backfire.

That these troubling situations that we face in water resources and other resource areas are far from new is illustrated by one of our oldest folk tales. There are many differing versions of this folk tale with many different details but the crux is as follows:

There is a person, often a fisherman, who does some good work such as freeing the fish from his net, and then inevitably the fisherman is granted three wishes. Invariably the fisherman wishes to request some benefit that the natural system does not seem to allow us such as instant wealth or power.

The fisherman's wish is a test. If the relatively simple first wish is granted, then obviously it will be possible to ask more and receive more grandiose results. And the first wish is granted, although it often turns out to be something less than totally satisfying to the fisherman.

So, the second wish the fisherman is granted both completes the first wish and demands far more. Yet the cumulative result is often insufficient. It is certainly unexpected and it's usually highly undesirable.

Thus, the third wish the fisherman is left with can only be expressed in one form: to undue the damage arising from the first two wishes.

The people who devised this folk tale and passed it along to so many following generations were referring to forces outside of nature, to supernatural forces. In recent generations, particularly in the current generation, those forces we have chosen in an effort to supersede nature have been technological forces.

I believe we can impose the structure of the folk tale of the fisherman's three wishes on what we have "wished," if you will, regarding our water resources.

For our first wish, we began with a comparatively small test of trying to manipulate the natural order that pertains to water. Our first job was to move water out of areas where we didn't want it, then obtain all the water we wanted where we wanted it, and when we wanted it.

Were we granted the wish? Illinois made natural impoundments covering 1.5 million acres of land area to augment our comparatively few natural lakes. Where surface waters were not conveniently available, we were able to tap groundwater. An estimated 5 million people in Illinois rely in whole or in

part on groundwater with 9 out of 10 of the public water systems drawing on underground aquifers.

We always have water when we want it. Except for precipitation, water is always there when we call it. We can move it--a community many miles from Lake Michigan can drink its water.

We must have decided that the first wish had been relatively successful, although like the fisherman, we were never totally satisfied with what has been accomplished. There is, after all, almost constant talk of a new reservoir needed somewhere, and the Chicago suburbs all seem to want Lake Michigan water because the groundwater is being mined. Basically, though, the small test we made with that first wish had been passed.

Then what was the second wish? To use water for any and all purposes to which we wanted it put.

Certainly we used it freely. In 1980, we in Illinois withdrew nearly 43 billion gallons of water per day. We drink it, bathe in it, clean everything with it. The average family of four in Illinois, if they are on a public water supply system, uses 750 gallons per day in 1980.

We want to swim in it, catch fish in it. We want to dilute our sewage in it. We have dumped industrial wastes in our water, used it to generate steam to produce electricity and to cool the equipment as well.

We are realizing right now (this conference is probably evidence of that) that although we did get our first two wishes in a way, we have found ways to get more water than Mother Nature readily provided and we have used it freely for any purposes we have chosen--the results of those two wishes are not quite what we expected. We did not really get what we thought we wanted, and now we are about to ask, in the desperation that the fisherman's third wish is always asked, for one last thing. We want to put it all right somehow.

Again, we are asking for the intervention of technology to somehow manipulate what naturally has taken place.

At the core of this technology is information. We need to find out, very rapidly, what chemicals are leaching into our groundwater supplies or lie in the muck of our groundwater and lakes and streams. We want to know how long it will take for aquifers to purge themselves? What are the health effects of pollutants? How long will it take depleted aquifers to replenish themselves? Can we influence the weather to get supplies of water to offset those whose quality is declining to unusable levels?

In short, what are the water costs of the activities that society has already carried out, and how in the future can we grasp, control and apportion these costs?

In conclusion, we have already used up our first two wishes, but we don't like the results. Like the fisherman, we are eager to make the third wish a wise one, and this one had better put things right.

We have already made choices that have drastically affected the water resources we will have in the 21st century.

The question that is left is based upon what we have already learned. The question is whether the third wish--that we can accumulate enough facts quickly enough and take the right steps in time--will be answered in the 21st century the way we want it answered. Thank you.

WATER RESOURCES IN THE 21ST CENTURY

Jacob D. Dumelle, Chairman
Illinois Pollution Control Board

I wanted to talk a little bit about the title of the panel we had on this morning which was called "The Referees." I think that is a good description for the regulatory agencies.

We have this troika in Illinois, that is the three-agency group that does the regulations, and it's kind of nice to think of them as referees. We have to decide the private interest and the public interest in the environment and in the resources that go into it, and decide how much contamination to allow and what species change to occur, if any.

So, I thought first to give you some sort of overview. Then I want to mention as I go along some specifics, because as an engineer I tend always to think in terms of specifics to illustrate whatever it is, the general thing that I am giving. I think in distilling out 12 years on the Board that there are a couple of tenets of environmental regulation. The first one is "don't be surprised," don't have anything creep up on you. If you think back to the early 1970s, we were discovering mercury in fish, and we discovered that the chlor-alkali plants were putting it in mercury, and we had to do something.

We found that the brown pelican and other birds were laying eggs with thin shells because of DDT in their bodies. We did something about that. In recent years we found out that vinyl chloride will cause cancer of the liver, and we are taking steps to tighten up on emissions of vinyl chloride.

We were surprised. Those crises crept up on us. They were part of the environmental crisis. Since then, what we want to try to do in all of the resource preservation and conservation, whether it's now or in the 21st Century, is to make sure we don't get surprised by something.

Another thing we don't want to do: we do not want to create irreversible effects, and we start first with public health. I think one of the reasons that most of the public is so much interested and alarmed about anything which is termed a carcinogen is because, to most people, it is looked upon as a death sentence to get cancer. With a cure rate of only about 30 percent, plus the suffering and mutilation and everything else, it just ranks very high on the public's priorities. That is certainly an irreversible effect, which is not to say that we ought to allow illness which is perhaps reversible (as against being irreversible) because that is an infringement on a person's private right to health. In the case of air contaminants it's forbidden by Congress, anyway. You have to have the level below that at which health effects occur, even the reversible types.

We don't want to create irreversible effects like losing a species. A major issue in the environmental movement today deals with the thousands and thousands of species in the Amazon Rain Forest which are going to disappear

very shortly. Some of those things may contain valuable plant gene pools which we can use for agriculture or medicines or several other things. We will lose them all unless somebody catalogs them. The forest is disappearing, and with it are some of those things which could be of great help to the world and the future.

Lastly we don't want a species to change from one thing to another just because of something that man does. If you look at Lake Michigan, for example, there were all kinds of very desirable commercial fish 50 years ago or so, and now we have alewives and other things. We have to stock in order to get fish. Those are the things we want to look at.

There are two basic problems as we talk about the 21st Century. One, what are some of the technical problems of water quality as such and two, what kind of a governmental structure do we use to achieve these kinds of things?

I suppose the hottest subject that my Board faces is the whole business of landfill siting. To date we have had three cases under Senate Bill 172 which, as you know, gives consent first to a county or a city, and as a double-barrel permit procedure the Illinois EPA is the second part of it. In contested permits on those, we have had cases involving Tazewell County, DuPage County and Saline County, and in all of those the question comes up of groundwater contamination. The big fear of most rural people and, in many cases, city people is that their groundwater is going to be contaminated. They get very, very upset about putting wastes in the ground, whether they are hazardous wastes or special wastes, right over their aquifer.

I think we have to look very closely at the whole design and control of landfills, and we are still learning. We are still on the scientific frontier.

We know now that certain organic solvents when they are put into a landfill, things like xylene and acetone, will affect the clay liner and make it more permeable. Those kinds of knowledge research is bringing to us. We have to keep that program going so that we know that we are not creating a hazard to the future and ruining an aquifer for future generations. We have many, many ponds, pits and lagoons on industrial property. I don't know the statistics in Illinois, but in the country, 70 percent of those are unlined. That means that they are probably permeating into the groundwater. We have to get a handle on them and prevent them from going too far.

Three and a half years ago my Board passed a manifest system requirement which is now in effect that is supposed to track wastes from cradle to grave, to make sure they end up in the correct landfill, and that they are disposed of correctly and properly. This is a great -- "great" in the sense of being a large paper -- operation. There are lots of copies of things that have to go around. These copies have to be matched up by the computer, and then there has to be some enforcement. My worry is that, with all of the cutbacks in governmental expenditures and everything, somewhere along the line we are not going to have enough manpower and enough resources to really follow that paper system and make sure that it's working, and to be sure that we are not getting phony paper in there, that we are really tracking completely, and it's doing what it's supposed to do. We have to have the fiscal resources to staff up on some of those systems.

Another technical problem on water -- and it's going to go on into the 21st Century -- is the whole business of airborne contaminants. What goes up comes down, more or less, except for Freon which keeps going up and diminishes the upper Ozone layer. Phosphorus comes into Lake Michigan from the air to the tune of about 3 million pounds a year. PCBs going into Lake Michigan. Toxaphene is said to be a problem in Lake Michigan fish. Zinc and cadmium, the scientists tell us, are making planktonic changes in Lake Michigan. This is a prime water resource for Illinois, and we need it badly. This is probably mostly a federal problem, because Lake Michigan is shared by the four states and other Great Lakes are similarly affected by airborne pollutants.

We need research as to where these pollutants are coming from and how to control them, and what the airborne contaminants are. We have got to keep up on the research. As the federal budget becomes reduced, the R and D budget for the EPA has been cut by 40 percent. We are going to end up "being surprised" by what we should not have happen to us. Perhaps by doing studies now, we might avert problems.

A last point on the technical side: we need to know whether things out there in the water right now are dangerous. The one example I have used in the Chicago area is the fact that there is asbestos out in Lake Michigan at the level of about 2 million fibers per liter. The water filtration plant takes out about 90 percent. You then end up with about 200,000 fibers per liter. One of the threshold questions has been "Does drinking water with asbestos in it really harm you?" I can't get a categorical answer at this time. I did see the abstract of a paper (and I don't have the full paper yet) which says that, based on some studies done in the San Francisco area, they are predicting one cancer case per year for each 100,000 people who drink in asbestos in drinking water at that level over a 70-year period.

With Lake Michigan water going out to the suburbs, about 6 million people in Illinois will be drawing Lake Michigan water. You divide that by 100,000 and you come out with 60 cases of cancer per year if the forecast is correct. I haven't read the full paper. I can't give you a judgment on that.

What I am saying is there does seem to be health evidence there that we ought to look at very seriously. Fortunately, I think it's possible to increase the efficiency of water treatment plants to take out more of that asbestos if it does turn out to be a valid hazard. There are other concerns about things in drinking water that we need to know more about.

Illinois now is under the Safe Drinking Water Act, and the rules promulgated by the Federal EPA. There are certain levels that are not to be exceeded for barium, for radium and for fluoride. In many public water supplies in Illinois, we are over those levels, sometimes by 300 percent, for barium, several times over for radium, many times over for fluoride.

The problem is that under the Safe Drinking Water Act my Board cannot give a variance to those water supplies after 1984 or 1986 if they were going to a regional water supply. What happens after that? What will happen is probably some of those very small suppliers will have to put in horrendously expensive removal equipment to bring down the barium, radium or fluoride.

What we really need to do now is verify those health levels to see if, perhaps, they are much, much too tight and could be safely loosened. Those are federal standards and there is not much Illinois can do about that.

So much for the technical problems, and some of the specifics. I think the point I am trying to make here, again, is that these particular problems - or any others that emerge - have to have some fiscal resources behind to look into them, whether it's epidemiology or treatment techniques or whatever.

The other part is what kind of a government structure do we have in the 21st Century to take care of our water resources? I think if you were designing something from scratch, you would want to have a structure that lets the public participate, lets them comment, come to hearings, and all of that, and I just want to tell you that we have it now. We have all of this available. My Board puts out a newsletter, the Illinois EPA puts out a monthly newsletter, Mike Witte puts out a newsletter. I keep running into people who are interested in environment and don't know about the newsletters or the three agencies.

I think we also want a system where you have access to what is in the system, where there are no secrets, where the files are open. We have that now. Since the 1970s, we've had "freedom of information" in environmental protection. I don't know how many people know it's there. You can ask for a file at my Board, sit down and read it, go into the Illinois EPA and do the same thing, unless it's a trade secret or unless in their case it's part of a litigation proceeding.

I think you need a system that will function even if one of the agencies for some reason - lack of resources or just a decision or a non-decision - doesn't do something, that the system itself can be entered into by the public and can get something considered, and we have that now. We have a citizens' initiative where anyone with 200 signatures can start a rule-making decision. We have had rulemakings started by others, mostly from industries. I think that right is not really fully appreciated.

We also need a system where you have to have a decision in a certain time, and we have that now. You can get a decision on a variance within 90 days, a decision on a permit application from the Illinois EPA within 90 days, and so forth. If you don't get it within the 90 days, it's deemed granted, so the backlogs don't build up; they move along. Sometimes we decide a case on the last possible day, and sometimes we ask for a two-week waiver, but we get those things decided and keep the thing moving.

I think we have a unique system. The problem is that a half generation has come along since Earth Day in 1970, and a lot of people don't know the system is there or how to use it, or what to do about it.

In conclusion, we have some technical problems. We have to keep the resources to make sure those get studied. We have a governmental structure which is pretty good right now. I think we ought to understand and use it. Thank you very much.

WATER RESOURCES IN THE 21ST CENTURY

Richard J. Carlson, Director
Illinois Environmental Protection Agency

Most of what I am going to say involves the structure of state government and how it relates to our ability to cope with water resource issues for the rest of this century, and hopefully to the 21st century as well.

By way of introduction, let me make a couple of comments. One of the reasons we are talking about water is that our perception of Illinois as a water-rich state has changed. I was looking over some of the recent articles in Illinois Issues, and the opening piece was entitled "Illinois, the OPEC of Water," a concept which was also a topic of conversation at the last Mid-western Governors' Conference. Water is one natural resource that we have in great abundance, and many Sunbelt states that have an abundance of sun but a shortage of water are looking at our fresh water supplies with envy.

But the appearance of abundance under some scenarios is faulty, as previous speakers have documented. Water resources are not distributed evenly throughout the state. There are areas where water conflicts have already developed or where shortages have already occurred. Communities in north-eastern Illinois, for example, are rapidly depleting the deep sandstone aquifer and are competing for Lake Michigan water. Withdrawals from the lake, of course, are limited by a U.S. Supreme Court consent decree and allocation of this scarce resource is the responsibility of the Illinois Department of Transportation.

There are areas in the southern part of the state which are periodically subject to drought. Some reservoirs in Central Illinois are slowly losing capacity as they fill up with sediment. When you look at situations within the state, you find that the appearance of abundance is not always accurate.

What I would really like to address is the extent to which public agencies, particularly those at the state level, are equipped to deal with emergency water resource management issues.

The title of this presentation might be more accurately called "Bureaucrats, Bureaucratic Politics and Bureaucratic Structure for the Rest of the 20th Century." I would like to take a closer look at how we as government bureaucrats are prepared to deal with water conflicts and related issues. Water as a single resource is subject to a variety of uses by people and institutions. Many of the uses and values represented by these people and institutions often come into conflict.

As I was making notes for this speech, it occurred to me that, from my perspective, a very real conflict occurs between sailors and people in powerboats, mostly on Lake Springfield. I bought a sailboat a year ago, and in the course of sailing, I developed a strong dislike for powerboats. This is in contrast to the last time I lived in Springfield and had a powerboat.

Then I was quite upset by people who sailed sailboats. This is a common conflict on Lake Springfield, usually on Sundays when the fleets are out racing on the larger portions of the lake.

Let me mention a few other conflicts that frequently occur when a single resource is subject to multiple uses. Levees and other flood control structures can alter the natural habitat of a stream. They can affect local drainage patterns, cause downstream water quality problems and impair recreational uses. Impoundments for water supply can eliminate wildlife habitats and impact downstream uses by sharply reducing the flow of water.

Withdrawal of water for power plant cooling needs can significantly affect instream water uses. Gravel and coal mining operations can interfere with water wells. Groundwater withdrawal in wells adjacent to streams can adversely affect return flow and instream water levels, while agricultural irrigation or drainage projects can affect downstream water levels.

Let me mention a specific example of the potential conflict between water quality and water quantity values. We have been discussing with the City of Decatur a proposal to slow the rate of sedimentation in Lake Decatur. Our concern as an agency is water quality. The city's concern is water quantity. We are trying to come to some kind of agreement on a technical strategy for reducing the build-up of sediment in Lake Decatur but without sacrificing the quality of the water in the lake or downstream.

Many people here represent other state agencies and can talk about water conflicts from their own particular perspectives. As a society, we want to use water for a lot of different purposes and some of those conflict with each other. At this point it becomes an issue for bureaucrats and public policy makers. As I mentioned before, each of us at the state level has a slightly different view of water resource management based upon our legal responsibilities and the programs that we run. We must sort out these responsibilities so that the state as a whole can be in an institutional position to develop intelligent policy about water resource management.

Let me mention some of the institutional problems that could impede a meaningful and comprehensive view of water resource management.

Mike Witte has described the water information needs of the state. After a year as an agency director making decisions on a daily basis about fairly significant kinds of events, I can say that it definitely helps to have good information. There is nothing that raises our anxiety level more than dealing with a very complex and significant issue and not having enough information to comfortably make an intelligent decision. At the state level we do have a fragmented information base. That is one problem we need to deal with. There can be too much information, but I would rather have too much than not enough.

As state agencies, we also need to spend more time defining obtainable water uses in specific areas of the state. Fortunately, that is something that we are working on. That is a major problem in terms of dealing intelligently with water resource management at the state level.

Each of us has a different sense of legal responsibilities. Some of us are closely identified with federal programs, as is my agency. So, we have different and sometimes conflicting management priorities. Since we are also separate structurally for the most part, there is a tendency for us to make decisions that ignore other agency programs. This can result in bad public policy making. It seems to me that when you have a fragmented government structure, the way that the government is able to think about an issue can often be fragmented as well, and intelligent thought about an issue is much more difficult.

We have to think about water competition as more than an issue of supply and demand. In the past, in terms of a lot of programs, we have looked at the extremes--too much or not enough water--and not spent enough time thinking about the more normal situations in which conflicts develop.

Partial thinking encourages technical solutions to a problem. We solve a flooding problem or a drought problem by engineering a solution, exclusive of other values. What we need is a more integrated management approach at the state level so we can think more intelligently about these issues and be more prepared as bureaucrats who advise politicians and run programs to deal with water resource issues.

We have begun to address these issues through the State Water Plan Task Force. At the direction of the Governor, all of the agencies in state government with responsibilities for water resource issues have been meeting since 1980 to identify emerging issues as well as those inadequately addressed by current programs.

While the process has been long, and a bit painful, I think we have been successful in developing an idea of where we need to go and with some preliminary ideas on how to get there. Let me mention some things the Task Force has identified that state agencies must deal with in a more intelligent fashion. Most of the agencies involved in the Task Force agree that we need a thorough appraisal of all the policies that exist in federal and state law so we can begin to manage our water resources from a more comprehensive perspective. We need integrated information that addresses the totality of the issues as opposed to the specific program interests that we have as individual agencies.

We also need to develop more effective working relationships between agencies. Here new interagency agreements can serve as ways to coordinate policy development and information management. State agencies must examine individual program goals in a more comprehensive context.

One issue of particular significance is the relationship between ground and surface water. Groundwater, particularly in the context of hazardous waste management, is a pressing concern and something about which we know far less than we do about the surface waters of the state.

I chose to talk about the bureaucratic and institutional side of things because I think the way the bureaucracy is organized has a direct impact on the

way we think and the information we have available to us as state agencies. In running our programs, we make decisions about water resource issues every day, but when conflict and major public policy issues arise, the legislature, the Governor and other levels of government become involved. In order for us to make a significant contribution to intelligent political decision-making, we need to be well organized, we need to have good information, and we need to have thought through the issues as well as we can as bureaucrats. It is our intention to work with the other agencies who are represented on the State Water Plan Task Force so that perhaps by the 21st Century--or even before--we can make that kind of contribution to the public dialogue on water resource issues in the State of Illinois.

Thank you very much.

Questions Addressed to Directors Carlson and Witte
and Chairman Dumelle

AUDIENCE PARTICIPANT: There was talk yesterday of regional water districts and water districts specially formed for special needs in special areas of the state. These would be substate units of water management. I would like to hear the reaction from any of you three gentlemen here to regulatory powers, how they could be passed on, or what other arrangements might be possible.

MR. WITTE: To my knowledge, we do not have in Illinois the authority to undertake regional planning or at least regulate it at a regional level that you are talking about. I think the general approach that Don [Vonnahme] was advocating - "Don't over regulate and apply water regulation throughout the state when perhaps you can solve the regional problems with regional approaches" - is a good one.

We need a person like Representative Reed still with us in the General Assembly. She worked hard last year, but did not get passed a bill which would have set up local water planning districts and begin to move in that direction. I think the concept is probably generally supported.

AUDIENCE PARTICIPANT: I have a question for Mr. Carlson. You mentioned the sedimentation problem at Lake Decatur. What is the EPA's main interest in that?

DR. CARLSON: Well, the city wants at the very least to be able to stop the sedimentation that is occurring now and building up in the bottom of the lake and diminishing the quantity of water available for the public water supply. They want to do it by bypassing sediment on their theory that it's all right to accept the stuff that is there, but to take the sediment coming from the upstream source and bypassing it to the other end of the lake and keep it from settling in the lake.

We have a concern with downstream water quality and the technique that they may use to get the sediment to go over to the dam at the end of the lake and back into the stream. So, our interest is primarily water quality. Their interest is saving Lake Decatur.

AUDIENCE PARTICIPANT: This is directed toward the interagency committee to all answer. Is the interagency committee looking at the ancillary effects of the specifically waste water force mains in terms of where they are located, not just of how they are built - specifically, where they are located with respect to Illinois agency reserves and groundwater supplies? Most of these things are built onto the design. When they fail, what happens then? Plus the fact that the project itself may have ancillary effects and impacts. I was wondering if the committee was looking at that.

DR. CARLSON: I will defer to anybody who attends the meetings more regularly than the director of EPA. To my knowledge, that specific issue has not been

addressed, but I am sure the committee who sits on it on a regular basis would be happy to talk to you about that.

AUDIENCE PARTICIPANT: I would like to build on a comment that was made earlier about Illinois being the OPEC of water and remind us all that OPEC really didn't have a great deal of clout until it learned how to price the commodity. Second, I would like to call upon a remark made that we need to get some kind of a consensus of values, but the essence of a democracy has been to learn to live without that consensus. So, I ask the three people who seem to have paid more attention to this than I, What thought has been given to appropriately pricing this resource which we could claim to be jointly owned by the citizens of Illinois to facilitate efficient use and allocation?

MR. WITTE: I don't think the Water Plan and Task Force addressed - correct me if I am wrong - the issue of pricing of water, at least in the comprehensive way that you as an economist want to treat it. I think the comment that you made, that it's not the role of the democracy to result in consensus, may or may not be true. But from my perspective, when government is involved in regulating (as you well know because of our own public utility regulations), the regulator's job is far more difficult when there is no consensus in society among the goals that you are seeking in a regulatory system with respect to public utilities.

Should they be providers of a social good at the lowest possible cost, or should they be a minimally regulated industry whose financial wealth we are simply there to maintain? What are we expecting of utility systems: lowest cost energy or most reliable? I think it's important to try to articulate what the goals of our water supply planning ought to be to the extent that we can reach consensus about a variety of interests about those goals. I think our planning would be more effective, but I don't think there has to be any serious attention paid, although it ought to be paid to the issues raised yesterday about the price of water.

AUDIENCE PARTICIPANT: May I ask a question, one for each of the gentlemen? Since Michael Witte was most frequently at the mike, I would like to ask if anyone in the state agency has been talking about the Clivus Multrum System. We have all been talking about how much water it takes to work with the sewage plants. I understand that this system uses no water. I have lost track. What has happened with it?

MR. WITTE: I can't answer specifically. People in my agency were following that system last year. We have been following unsuccessfully and we have been trying to follow a study on it in St. Louis. No, we haven't paid serious attention.

AUDIENCE PARTICIPANT: In the small town areas we are badly hurt when we are required...the cost is getting awful. Mr. Dumelle, I would like to hear very much a little more about the 200-signature rule possibility.

MR. DUMELLE: If anyone thinks there ought to be a rule, they can file as long as it's within our power. We had a rule come in once to regulate indoor smoking. We said "ambient air" means "outside areas." We can't go beyond the powers. The other requirement is that there cannot have been a hearing

on that rule within the last six months. That starts the rule-making process. That doesn't mean that you can necessarily get the rule enacted. It depends on the Board's decision and the economic studies and all of the other things that go into it, but you will get the process started. You will get hearings.

AUDIENCE PARTICIPANT: Could I ask Dr. Carlson about the job qualifications for people working in the state agencies that deal with natural systems. I have quickly reviewed everyone listed at the conference here, and I know that many of the backgrounds include ecological or system dynamics, but my experience is that in several departments I understand that engineering is a prime qualification. It would be appropriate to look at some of the background qualifications so that we are working with policy makers who have more of a realistic approach, namely, background on ecology or system dynamics at the state level.

DR. CARLSON: The question was whether or not we have too many engineers in the state agency, and not enough people who can look at the environment as a whole. Maybe we could do a better job if we had more people who were trained to do that. We have a lot of engineers in the agency. We do have a lot of lawyers. We have one of the engineers sitting right behind you there. They are not overwhelmingly predominant. We have environmental specialists for which the basic requirement is a natural science degree. A lot of those people are in relatively high policy-making positions in the agency. Although we sometimes get excited with the lawyers and engineers, the environmental protection specialists are there to mediate. There is a role for those kinds of people, and there are people like that around.

AUDIENCE PARTICIPANT: I have been listening for the word "watershed" sometime during this conference. They have a lot more powers than just regulatory powers, and I am wondering what kind of assistance they might be able to provide for watershed maintenance. In other words, building a maintenance fee that was talked about this morning into the costs of the project. If there is going to be a new reservoir, perhaps there should be some maintenance fees just as there are for building a courthouse. I would like to have a comment from perhaps Director Carlson.

DR. CARLSON: I am not sure I understand your question.

AUDIENCE PARTICIPANT: Watershed maintenance. If we are going to have water projects, should we be requiring, in a regulatory process, that there is a watershed maintenance fee built into it? That there is a guarantee that Lake Decatur will not be filled up with sediment in 5 years or 10 years.

DR. CARLSON: You mean the notion that the resource belongs to all the people who use it, and using it in a consumptive way ought to be associated with a fee which can be reinvested in a watershed, something like that? Well, I know that late at night some of the bureaucrats talk about things like that, and if we move more to a notion of stewardship and investment in the natural resources of the state, some wild, woolly-headed engineers might move to that kind of a system. I don't think it has ever been debated in public except in meetings like that. I have not thought about it a lot, but I know my predecessors have, and some of the other people in the agency.

BIOGRAPHICAL SKETCHES OF SPEAKERS

C. R. BASKIN

TEXAS DEPARTMENT OF WATER RESOURCES

Associated with Texas water agencies for the past 24 years, Mr. Baskin is currently responsible for staff and program direction of the Data and Engineering Services Division of the Texas Department of Water Resources. In addition, Mr. Baskin serves as chairman of the interagency Texas Natural Resources Information System Task Force, the Texas Mapping Advisory Committee, and the Water Data Coordination Task Force of the Interstate Conference on Water Problems. He is a member of the Department of the Interior's Advisory Committee (to the U.S. Geological Survey) on Water Data for Public Use and serves as chairman of its Subcommittee on Water Data Exchange and is also a member of its Subcommittee to develop the handbook on "Recommended Methods for Water Data Acquisition."

A Registered Professional Engineer in Texas and Louisiana, Mr. Baskin began his professional career with four years of municipal engineering work in the Louisiana cities of Baton Rouge and Plaquemine.

Mr. Baskin received his B.S. in Civil Engineering from Louisiana State University in 1953. In 1972 Mr. Baskin was awarded the John Wesley Powell Award for citizen's achievement from the U.S. Geological Survey.

FRANK M. BEAVER

ILLINOIS DEPARTMENT OF ENERGY AND NATURAL RESOURCES

Mr. Beaver is currently director of the Policy and Planning Division of the Illinois Department of Energy and Natural Resources. In this capacity his responsibilities include managing and coordinating energy and natural resources planning and research for the Department and the development of policies to enhance and protect the state's resources. Mr. Beaver is responsible for other programs which interface energy and natural resource issues. Included are the Lands Unsuitable for Mining Program in support of the Federal Surface Mining Control and Reclamation Act and contributions to the State Water Plan, primarily focusing on the competition for water issues which include water for energy development. Previously, Mr. Beaver was the manager of the Resource Development Division and was responsible for planning and managing the State of Illinois' energy development programs for coal, solar, wind, biomass and hydropower.

A graduate of Kansas State University (B.S. in Zoology) and Sangamon State University (M.A. in Public Administration), Mr. Beaver has worked in resource planning for the State of Illinois since 1971. Before joining ENR, he was with the Illinois Environmental Protection Agency where he managed the state's "208" Water Quality Management Planning Program and facilities planning in support of the U.S. Environmental Protection Agency's sewage treatment facilities construction grants program. Prior to his employment with the State of Illinois, Mr. Beaver was a safety officer in the Air Force with primary responsibility in nuclear safety programs.

RICHARD J. CARLSON

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

Richard Carlson was appointed director of the Illinois Environmental Protection Agency in September 1981. Prior to this appointment, he served as the assistant to Governor James R. Thompson on energy, environmental and natural resource issues. In this position his duties included liaison with the Illinois Commerce Commission, the Institute of Natural Resources (now ENR), the Illinois Environmental Protection Agency, Division of Water Resources, and the departments of Agriculture and Mines and Minerals.

From 1977 to 1979, Dr. Carlson served as assistant to Governor Thompson on organization and management issues, primarily focusing on reorganization of executive branch agencies. Preceding this position, Dr. Carlson was director of research at the Council of State Governments, Lexington, Kentucky, from 1974 to 1977, and was an adjunct professor in the Graduate School of Public Affairs in 1976 at Kentucky State University. From 1971 to 1974, he was director of the Election Systems Project of the National Municipal League in New York.

Dr. Carlson has a B.S. in Communications, M.S. in Journalism, and Ph.D. in Political Science, all from the University of Illinois at Urbana-Champaign.

STANLEY A. CHANGNON, JR.

ILLINOIS STATE WATER SURVEY, ENR

Stanley A. Changnon, Jr., has been chief of the Illinois State Water Survey since 1980. He served from 1954 to 1968 as the climatologist on the staff of the Illinois State Water Survey. He was head of the Atmospheric Sciences Section from 1969 to 1979 and is also a professor of geography at the

University of Illinois. Mr. Changnon has authored more than 240 scientific and technical papers and reports concerning meteorology, climatology and water resources. One hundred thirty-five of these have been published in various scientific and technical journals.

For a paper he co-authored, he was chosen by the American Geophysical Union as the 1964 recipient of the Robert E. Horton Award presented for the most outstanding paper in hydrology published in 1964. Another paper was recognized by the Building Research Institute in 1966 as a "Scientific Contribution to the Science of Building," and a 1976 paper was awarded the best of the year in the Water Resources Bulletin by the American Water Resources Association. The American Meteorological Society awarded him the Cleveland Abbe Award in 1981 for outstanding research contributions.

Mr. Changnon obtained his B.S. degree with honors from the University of Illinois in 1951 and obtained his M.S. degree from the same institution in 1956.

He is a member of Sigma Xi, Pi Mu Epsilon, Illinois Academy of Science, American Geophysical Union, American Association for the Advancement of Science (past Secretary of Section W), Weather Modification Association (past president), American Association of State Climatologists (president), and the American Meteorological Society (AMS). Mr. Changnon was also chief editor of the Journal of Applied Meteorology. Because of his contributions to the atmospheric sciences, he was chosen to be a Fellow of both the AMS and AAAS. He was also elected Councilor in the AMS in 1974.

BARRY COMMONER

QUEENS COLLEGE

Barry Commoner is director of the Center for the Biology of Natural Systems and professor in the Department of Earth and Environmental Science at Queens College. He is also currently a visiting professor of community health at the Albert Einstein College of Medicine. Prior to this, he was professor of environmental science at Washington University in St. Louis.

Dr. Commoner has published numerous books and papers including The Politics of Energy, The Poverty of Power and The Closing Circle, "Energy and Rural People," "Cost-Risk-Benefit Analysis of Nitrogen Fertilization," "The Solar Transition," "The Public Interest in Nuclear Power," and "Energy, Employment, and the Environment." Dr. Commoner is a well-known speaker on the conference circuit and has been asked frequently to give testimony before various Congressional committees and hearings.

The recipient of numerous awards, Dr. Commoner received the Phi Beta Kappa Award in 1972 and the International Prize for Safeguarding the Environment from the City of Cervia, Italy, in 1973 for The Closing Circle. In 1978 he was awarded the Premio Iglesias (Sardinia, Italy) for The Poverty of Power and in 1982 the Premio Iglesias (Sardinia, Italy) for The Politics of Energy. Dr. Commoner was awarded the First International Humanist Award by the International Humanist and Ethical Union in 1970 and the American Institute of Architects Medal in 1979. He is also the recipient of several honorary doctorates.

Dr. Commoner received his A.B. in Zoology at Columbia University in 1937, his M.A. in Biology at Harvard in 1938 and his Ph.D. also in Biology at Harvard in 1941.

JACOB D. DUMELLE

ILLINOIS POLLUTION CONTROL BOARD

Jacob D. Dumelle, P.E., chairman of the Illinois Pollution Control Board, has been on the Board since it was created on July 1, 1970. He is a mechanical engineer (Illinois Institute of Technology - 1947) and holds the M.S. degree in public engineering administration (Illinois Institute of Technology - 1950).

Mr. Dumelle was the former city manager of Lebanon, New Hampshire and was assistant to the managers of Brookfield, Illinois and Peoria, Illinois. He has also served with the federal government and the Metropolitan Sanitary District of Greater Chicago as an assistant chief engineer.

Mr. Dumelle has written more than 50 articles and reports on the environment or on governmental administration. In 1975 he received the Environmental Quality Award from the U.S. Environmental Protection Agency - Region V, and in 1980 he was the recipient of the 10th Anniversary Earth Day Award from the Illinois Environmental Council.

JOHN FOLK-WILLIAMS

WESTERN NETWORK

John Folk-Williams is president of Western Network, a new non-profit organization examining natural resource conflicts and methods of decision making in the western states. He is author of the recent Western Network publication, What Indian Water Means to the West, the first of a series of source books surveying conflicts about water in the region which document and analyze new proposals for improving decisional processes. Before establishing Western Network, Mr. Folk-Williams spent 12 years as a representative of several private foundations specializing in American Indian and natural resource issues. He has written numerous articles on Indian problems, including "The American Indian: An Overview of the Issues" published by the Lilly Endowment. He is a graduate of Harvard University and now lives in Santa Fe, New Mexico.

WILLIAM W. FRERICHS

ILLINOIS DEPARTMENT OF ENERGY AND NATURAL RESOURCES

Mr. Frerichs is currently manager of the Research Section at the Illinois Department of Energy and Natural Resources where he oversees two million dollars' worth of environmental research a year and the development of a land evaluation program. He has contributed to the development of the State Water Plan and policy analysis on a variety of water issues.

A graduate of the University of Wisconsin - Madison (B.S. in Natural Resources), Mr. Frerichs has worked in resource analysis and planning since 1964. Before joining ENR, he was with the Illinois Environmental Protection Agency and was responsible for major portions of the State Water Quality Management Plan. Prior to his tenure at IEPA, Mr. Frerichs worked with local planning agencies and conducted geophysical investigations around the world.

STEVE H. HANKE

THE JOHNS HOPKINS UNIVERSITY

Steve H. Hanke is a professor of applied economics at The Johns Hopkins University. He is also currently an Adjunct Scholar at the Heritage Foundation and at the CATO Institute, both in Washington, D.C. In 1981 he was appointed a Distinguished Visiting Scholar at the Institute of Technology, University of Lund, Lund, Sweden, and in 1979-80 as an Associate Research Scholar at the International Institute for Applied Systems Analysis in Schloss Laxenburg, Austria. Prior to his appointment at Johns Hopkins, he taught in the Graduate School of Public Policy at the University of California at Berkeley and at the Colorado School of Mines. He holds a B.S. and Ph.D. from the University of Colorado.

Professor Hanke took a year's leave of absence in 1981-82 to serve as senior economist for the President's Council of Economic Advisors. Dr. Hanke also was a member of the Maryland Governor's Office of Economic Advisors from 1976 to 1980 and served as chief economic advisor from 1977 to 1980 to Binnie and Partners, Consulting Engineers in London, England.

From 1975 to 1979 Professor Hanke was the associate editor of Water Resources Research, and from 1980 to 1982 he was the economic editor for Water Engineering and Management (formerly Water and Sewage Works). Presently, Dr. Hanke is serving as a member of the Editorial Board of Water Resources Bulletin; on the Advisory Council, Political Economy Research Center, Bozeman, Montana; a member of the National Advisory Board, American Land Alliance, Mountain View, California and a member of the Advisory Board of the Reason Foundation in Santa Barbara, California.

THOMAS L. KIMBALL

NATIONAL WILDLIFE FEDERATION

Thomas Kimball, honorary president of the National Wildlife Federation, served as its executive director from 1960 to 1981. Prior to this, he was the executive director of the Colorado Fish, Game, and Parks Department and of the Arizona Fish and Game Department.

Dr. Kimball received his B.S. at Brigham Young University in 1939 and a D.Sc. from Colorado State University in 1975. He was awarded an Outstanding Service Award by the Colorado Fish and Game Department and by the Izaak Walton League in 1960, a Conservation Service Award by the U.S. Department of Interior in 1964, Distinguished Citizen's Award by the University of Arizona in 1964, the Eugene Baker Memorial Award in 1965 and the Audubon Medal in 1979.

Dr. Kimball is a Fellow of the American Association for the Advancement of Science and a member of the Wildlife Society, the American Fisheries Society and the Society of American Foresters.

DOTTY KIRKWOOD-HAMILTON
FLORIDA WILDLIFE FEDERATION

A Phi Beta Kappa graduate of the University of Missouri, Ms. Kirkwood-Hamilton moved to Florida in 1972. As a television news producer, she has sought to enlighten the public on environmental issues. Her documentary work on Florida water problems was widely acclaimed in South Florida and is used by schools and conservation groups to educate students and civic groups. In 1981 her work was viewed during hearings of the Florida Senate Committee on Natural Resources. Ms. Kirkwood-Hamilton was named Communicator of the Year in 1981 by the Florida Wildlife Federation for a television special she produced on South Florida water problems. In 1982 she conceived a project to increase awareness of Florida's natural resources. Now underway, Project ALLIES, sponsored by the Florida Wildlife Federation, will produce a six-week audio-visual course on Florida environmental problems for distribution to public schools statewide.

FRED POWLEDGE
JOURNALIST AND AUTHOR

Fred Powledge is the author of several books and numerous magazine articles on a great variety of subjects. His books range from reports on race relations (Black Power/White Resistance, 1967) to circus life (Mud Show: A Circus Season, 1975) to a cookbook for backpackers (The Backpacker's Budget Food Book, 1977). The most recent of his nine books is Water: The Nature, Uses, and Future of Our Most Precious and Abused Resource, published in August 1982, by Farrar, Straus and Giroux.

His articles have appeared in a number of publications, including The New Yorker, Life, The Nation, Playboy, Family Circle, Redbook, Esquire, and New York Magazine. Prior to becoming a freelance writer in 1966, Mr. Powledge was a reporter for The New York Times, specializing in race relations and urban problems. He covered the civil rights movement during the '60s for The Times and prior to that for The Atlanta Journal. He started his journalism career as a writer and editor for the Associated Press in 1958.

Mr. Powledge received his A.B. in English at the University of North Carolina in 1957 and was a Russell Sage Fellow in Journalism and the Behavioral Sciences at Columbia University in 1966-67.

THE HONORABLE BETTY LOU REED
REPRESENTATIVE, ILLINOIS GENERAL ASSEMBLY

The Honorable Betty Lou Reed, Deerfield, Illinois, served as the State Representative to the Illinois General Assembly from the 32nd District from 1974 to 1982. While in the legislature, Mrs. Reed served as chairman of the Illinois Water Resources Commission. In addition, Representative Reed also served on the Aeronautics Advisory Commission and on several standing legislative committees including the Elementary and Secondary Education Committee, the Conservation and Natural Resources Committee, and the Energy and Environment Committee. Mrs. Reed retired from her seat in the General Assembly in January 1983 and is currently working as executive assistant to Congressman John Porter. She is also serving on the International Lakes Level Advisory Board to the International Joint Commission [on the Great Lakes].

Prior to her election as State Representative, Mrs. Reed was a field representative for the Illinois Department of Local Government Affairs from 1972 to 1973; supervisor of the Lake County, Illinois, Board of Supervisors (elected) from 1968 to 1972; a member of the West Deerfield Committee on Youth, 1972 to 1974; commissioner of the Lake County Forest Preserve (elected) from 1969 to 1972; president of the Lake County Township Officials Association, 1971-72; and a member of the Midwest Region Advisory Council, Small Business Administration from 1971 to 1972.

WARREN VIESSMAN, JR.
CONGRESSIONAL RESEARCH SERVICE
LIBRARY OF CONGRESS

Warren Viessman, Jr. is Senior Specialist in Engineering and Public Works, Congressional Research Service, Library of Congress. From 1968 to 1975, he was director of the Nebraska Water Resources Research Institute, and from 1965 to 1968 he served as director of the Water Resources Center of the University of Maine. Dr. Viessman is co-author of textbooks on water supply and pollution control and hydrology. He has written extensively in the professional literature, served on numerous national, regional and state committees, was executive secretary of the Universities Council on Water Resources from 1971 to 1975 and is a Registered Professional Engineer. He was educated in Baltimore, Maryland, and received his doctorate from Johns Hopkins University in 1961.

DONALD R. VONNAHME
DIVISION OF WATER RESOURCES
ILLINOIS DEPARTMENT OF TRANSPORTATION

In August 1982, Donald Vonnahme was named director of the Division of Water Resources, Illinois Department of Transportation. Prior to this appointment, he had served as the Division's deputy director since 1976. From 1972 to 1976 he was the office manager/design engineer for Metcalf and Eddy/AM&G.

A 1964 graduate of the University of Illinois (B.S. in Civil Engineering), Mr. Vonnahme is the chairman of the Illinois State Water Plan Task Force. He also serves as the Illinois commissioner to the Ohio River Basin Commission, the Great Lakes Commission and the Upper Mississippi River Basin Association. In addition, he is a member of the Board of Directors of the National Association of Urban Flood Management Agencies, of the National Governors' Association - Water Management Committee and Transportation Committee, the American Association of State Highway and Transportation Officials - Water Transportation Committee, and the Governor's Natural Resources Subcabinet. Mr. Vonnahme is a Registered Professional Engineer in Illinois and Missouri.

MICHAEL B. WITTE
ILLINOIS DEPARTMENT OF ENERGY AND NATURAL RESOURCES

After having served for four months as acting director, in March 1982, Michael B. Witte was appointed the director of the Illinois Department of Energy and Natural Resources, a cabinet-level department reporting to the Governor.

Director Witte is currently chairman of the Board of Natural Resources and Conservation, chairman of the Energy Review Board, chairman of the Illinois Coal Research Board, a member of the Illinois State Museum Board, and chairman of the Governor's Sunset Task Force on Utility Regulatory Reform.

Prior to becoming director, Mr. Witte served as deputy director of ENR. Since January 1977, he has served in Illinois state government in a number of other management capacities, including assistant director of the Institute of Natural Resources, assistant director of the Division of Energy in the former Department of Business and Economic Development, and manager of the state's energy conservation programs.

Mr. Witte is a graduate of the University of Michigan and is pursuing a master's program at the University of Illinois.

BRIEF HISTORY OF ILLINOIS DEPARTMENT OF ENERGY AND NATURAL RESOURCES

In March 1978, an executive action initiated the process from which ENR grew. The new agency created by this action was called the Illinois Institute of Energy and Environmental Resources and included the state's energy office -- previously part of the Department of Business and Economic Development (BED) -- and the Institute for Environmental Quality.

The newborn agency got a new name and added four components following a legislative action in July 1978. This changed the name to the Institute of Natural Resources and added the three scientific surveys and the state museum to the agency ranks. This change reflected the lawmakers' realization that many natural resource issues are inherently interrelated. In order to make wise decisions regarding resource use and management, it is often vital to have a clear understanding of how these resources affect the environment and each other.

In September 1981, Public Act 82-592 changed the Illinois Institute of Natural Resources to the Illinois Department of Energy and Natural Resources. Although the name change did not change ENR's responsibilities, it did acknowledge that more emphasis is being placed on energy resource development and expansion, areas which are becoming increasingly important to the state's well-being.

Today, ENR is composed of six divisions:

Energy Programs. This division encourages the development of new energy technologies and offers direct services to Illinois residents interested in making more efficient use of energy resources. The two areas which receive special emphasis from this division are promotion of Illinois' native energy resources and the use of energy conservation techniques.

Geological Survey. Established in 1851, this division maps the geological formations and mineral resources of the state, then determines their chemical and physical properties. Educational programs are available to schools and the public.

Natural History Survey. Studies on plant and animal resources of the state are the focus of this division, which was established in 1858. Classification of environments and control of insect pests are among the many research activities conducted by the division.

Policy and Planning. This division conducts applied environmental and economic research intended to guide the state's policy decisions. An annual conference focusing on an energy- or natural resource-related issue is coordinated by this division.

State Museum. The state's natural history, art and anthropological history are collected, preserved and interpreted by this division. Established in 1877, this division displays and prepares exhibits of many historic objects and offers a variety of public educational programs.

Water Survey. This division researches questions on the quantity and quality of atmospheric, surface and underground water resources in Illinois. Studies of water use and conservation, development of water supplies, water resource planning and management and meteorological factors that affect water resources are prepared and distributed.

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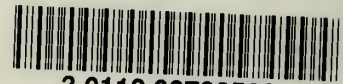
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